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RAM FOR EXTRUSION PRESSES.

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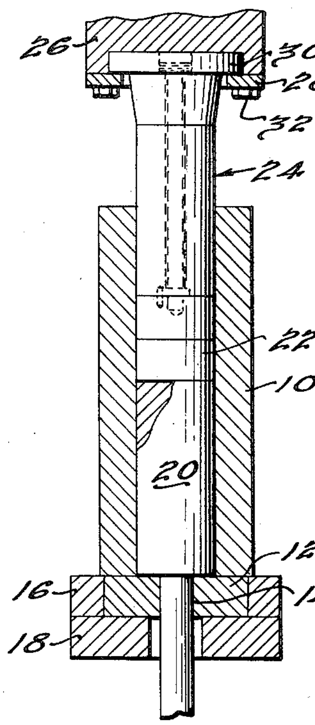

FIG. 1.

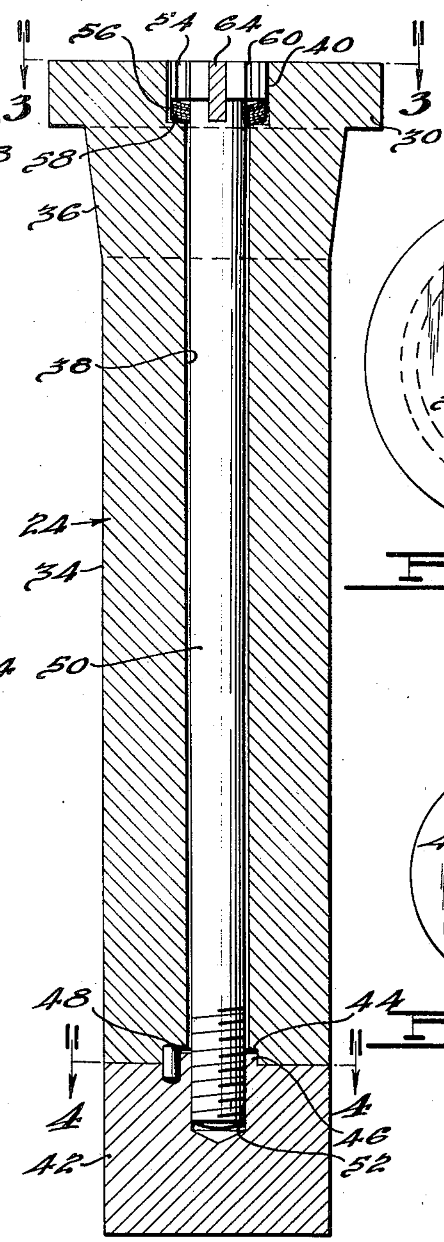

FIG. 2.

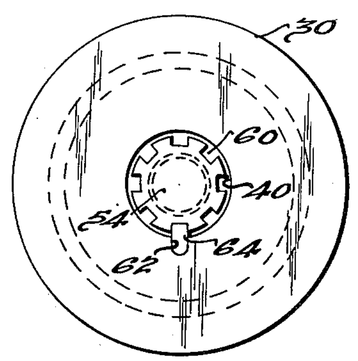

FIG. 3.

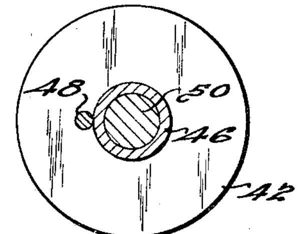

FIG. 4.

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RAM FOR EXTRUSION PRESSES

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12 Claims. (Cl. 207—19)

This invention relates to rams for extrusion presses and other like uses, the principal object being the provision of a ram of this type that is highly efficient in operation, capable of withstanding the severe usage to which such rams are subjected in service without rapid deterioration, and that is relatively economical to manufacture and to service.

Objects of the invention include the provision of an extrusion ram so constructed and arranged as to be capable of withstanding high compression columnar stresses and bending produced thereby and hardened and tempered in an improved manner; the provision of a ram of the type described which is hardened and tempered and includes a main body portion of hollow conformation enabling a more uniform hardness to be obtained in the same than is possible in conventional constructions; the provision of a ram of the type described so constructed and arranged as to minimize its tendency to warp in hardening and bend in service yet capable of withstanding the high pressures and temperatures required in service without mushing of the operative end thereof; the provision of a ram of the type described including a hollow main body portion so constructed and arranged as to minimize danger of warpage thereof in hardening and to provide a maximum resistance to bending in service, together with a nose portion so constructed and arranged as to be capable of withstanding the high temperatures and high pressures met with in service without mushing, together with means releasably securing the nose piece of the main body portion together; the provision of a ram of the type described in which the main body portion and the nose piece are formed of materials having materially different characteristics; the provision of a ram of the type described formed for special co-action between the nose piece and the main body portion; the provision of a ram of the type described having a novel means for securing the nose piece and the main body portion together; and the provision of a ram of the type described that is simple in construction, efficient in operation and economical to produce.

The above being among the objects of the present invention, the same consists in certain novel features of construction and combinations of parts to be hereinafter described with reference to the accompanying drawing, and then claimed, having the above and other objects in view.

In the accompanying drawing which illustrates a suitable embodiment of the present invention and in which like numerals refer to like parts throughout the several different views,

Fig. 1 is a more or less diagrammatic partially broken, partially sectioned view of an extrusion press provided with an extrusion ram constructed in accordance with the present invention;

Fig. 2 is an enlarged sectional view taken in a plane passing diametrically through the extrusion ram shown in Fig. 1;

Fig. 3 is an end elevational view of the ram shown in Fig. 2 taken on the line 3—3 of Fig. 2; and,

Fig. 4 is a transverse sectional view taken on the line 4—4 of Fig. 2.

As is well understood by those skilled in the art, rams used in the extrusion of metals and particularly those employed in the extrusion of ferrous metals, copper, brass, aluminum and the like are required to withstand tremendous pressures and relatively high temperatures. Additionally the operative end of the ram must be of sufficient hardness to properly withstand the scoring or abrading action arising due to its contact with the cylinder liner during an extrusion operation. Conventional practice is to make such rams solid and of a suitable steel, and subject the ram to a suitable hardening and drawing operation which results in the ram having a Brinell hardness of appoximately 450 which it will maintain under the temperatures met with in service. Such hardness is usually sufficient to prevent the nose or operative end of the ram from unduly mushing under the high temperatures and pressures met with in service, as well as to suitably withstand the abrading action of the ram on the liner. However, because of the fact that these rams are made solid, and because of their relatively large diameter, the hardening operation sets up internal stresses within them due to the difference in hardness between the inside and the outside of the ram. It has been found that because of these internal stresses which act to preload the material of the ram, slight misalignments in the press in which the ram works causes the ram to bend. I have found that by reducing the surface hardness of the solid ram to 350 Brinell, the internal hardening stresses are reduced to such an extent as to overcome the bending above referred to, but when this is done the nose portion of the ram does not exhibit the good wearing properties thereof desired in service.

Nose pieces of special alloy steel have been electrically welded to the ends of solid rams as above described so as to provide them with an end portion capable of withstanding the high temperatures met with in service without affecting the extreme hardness which it is possible to obtain in such special alloys. The addition of such special alloy nose pieces has been accomplished particularly in connection with the salvaging of conventional types of rams in which the ends or noses have become so worn, upset or otherwise affected in service as to render them no longer suitable for use. In salvaging rams in this manner, in order to prevent reduction in the diameter of the ram, it is first necessary to upset the nose end of the ram to be salvaged so that enough stock is available for subsequent machining. After upsetting, the nose end of the ram is trimmed down to permit the introduction of the special analysis nose piece and this nose piece is then electrically welded to the shank. Following the welding it is necessary to re-heat treat the shank and to heat treat the nose. The nose being of a special heat resisting material and the shank having essentially high physical properties after heat treatment, the heat treatment employed for the welded composite rams must necessarily be a compromise between that most desirable for the shank and that most desirable for the nose, with the result that neither the shank nor the nose are provided with the heat treat most desirable for the physical properties desired in them.

It has been suggested heretofore to employ a separate nose piece of a special alloy steel as above referred to and to secure it upon the end of a solid ram by means of a stud or the like. While such construction permits the nose piece to be replaced upon becoming worn, and permits the nose piece on the main body portion of the shank to be hardened independently of one another and thus avoid the disadvantages of the welded construction above referred to, the connection between the nose piece and the main body portion of the ram is not satisfactory for the reason that, due to the repeated cooling and heating of the end of the ram the type of connection employed permitted looseness to develop between the nose piece and the main body portion and, additionally, the main body portion of the ram being solid still retains the disadvantages referred to caused by the internal stresses set up in it during the hardening operation where the main body portion is hardened to the desired degree.

The present invention provides a construction whereby the disadvantages of conventional and heretofore suggested constructions are eliminated in an exceptionally simple manner, it provides a construction wherein the main body portion of the ram may be hardened to an exceptionally high degree without developing any undue internal stresses, provides the separate nose piece with all the advantages thereof, and provides a means of securing the nose piece to the main body portion of the ram so as to permit it to be separately machined and hardened and removed for replacement and yet such as to maintain the security of its connection with the main body portion of the ram for the life of the ram. To overcome the disadvantages of the conventional solid type ram arising because of the internal stresses in hardening above referred to, the ram provided in accordance with the present invention has a tubular or hollow main body portion. The hollow shank or main body portion is of advantage for two reasons, one of which is that it is stronger from a standpoint of bending caused by columnar compression stresses than if it were solid, and the other is, that being hollow it is possible to harden it to higher physical properties because the hollow construction permits a more even hardness to be obtained throughout the wall thickness than in a solid ram and this also eliminates to a great extent the internal stresses, previously mentioned, which are set up in solid rams and which cause preloading of the material thereof resulting in bending of the ram in service.

Referring now to the accompanying drawing and particularly to Fig. 1 the essential elements of an extruding press are more or less diagrammatically illustrated as including a cylinder liner 10 for a conventional cylinder (not shown), an extruding die 12 closing one end of the liner 10 and provided with an opening 14 therethrough which may be of any suitable or desirable cross-sectional configuration and which determines the size and shape of the extruded work, a die ring 16 surrounding the extruding die 12, and a backer plate 18 for the extruding die 12. Within the liner 10 is shown received a billet 20 formed of the material which it is desired to extrude in the press and while such material may be any one of a variety of different metals or alloys, either ferrous or non-ferrous, for the purposes of illustration only it may be assumed to be copper or brass and which is preferably brought to a temperature which may be around 1100° F. to 1200° F. for the purpose of and during the extruding operation. Received within the liner 10 upon the upper end of the billet 20 is a so-called dummy block 22 provided in accordance with conventional practice to prevent direct contact between the end of the extrusion ram and the heated billet 20, and the dummy block 22 is followed by the extrusion ram indicated generally at 24, shown as constructed in accordance with the present invention and supported at its upper end in the ram 26 of a hydraulic press or other suitable pressure producing apparatus and maintained in place thereon by means of a clamping ring 28 overlying the flange 30 of the ram 24 and secured in position by means of bolts 32. It will be understood that in operation the ram 24 and dummy block 22 are removed from the liner 10, a billet 20 is introduced into the liner and is followed by the dummy block 22 and ram 24, the ram 24 exerting sufficient pressure through the dummy block 22 upon the billet 20 to cause the billet 20 to be extruded through the opening 14 in the extruding die 12.

Referring now to Figs 2, 3 and 4 it will be noted that the ram 24 includes a main body portion or shank 34 of cylindrical construction throughout except at its attaching end which is slightly flared out as at 36 to the attaching flange 30, primarily for the purpose of added strength and rigidity at this point. The main body portion of the shank 24 is provided with an axial cylindrical opening 38 extending completely through it from end to end and the opening 38 is enlarged as at 40 at the flanged end of the main body portion or shank for a purpose which will hereinafter be more fully brought out. The ratio of the diameter of the main body portion 34 to the diameter of the bore 38 to obtain maximum columnar strength of the main body portion and yet reduce the occurrence of internal stresses in the material thereof in accordance with the present invention is preferably 5 to 1, although this ratio may vary between 4 to 1 and 6 to 1 and still obtain the advantage of the present construction. That end of the main body portion or shank **34** opposite the flange **30** is provided with a separate and removable nose piece **42** of the same diameter as the main portion of the shank **34** and arranged concentrically therewith. For insuring such concentricity the bore **38** at the adjacent end of the main body portion **34** is enlarged to form a recess **44** and the nose piece **42** is provided with an axially projecting pilot **46** for relatively close reception therein. The length of the pilot **46** is less than the depth of the recess **44** so as to insure against contact of the end of the pilot with the bottom of the recess **44**, and to limit the pressure transmitting faces between the main body portion **34** and the nose **42** to those surfaces thereof radially outwardly of the pilot **46**. In order that these surfaces may be of maximum area so as to minimize as far as possible the unit pressure transmitted between said faces during an extruding operation, the recess **44** and pilot **46** are, measured in a diametrical direction, made as small as is practically feasible. In order to prevent relative turning between the nose piece **42** and the main body portion **34**, a relatively short dowel **48** is received in the opposed faces of these parts.

The length of the nose piece **42** is preferably less than its diameter where the nose piece is of circular section, and less than a corresponding dimension where not of circular section, and preferably is approximately two-thirds as long as its greatest transverse dimension so as particularly to relieve the draw bolt, to be later described, from being subjected to bending stresses when the ram is operating on a billet having an inclined end face.

In order to secure the nose piece **42** to the main body portion **34**, a draw bolt **50** extends through the bore **38** in the main body portion **34** and is provided with a threaded end which is threadably received in a cooperating blind opening **52** formed axially in the nose piece **42** and centrally of the pilot **46** thereon. The draw bolt **38** is preferably relatively loosely received in the bore **38** so as to remain out of actual contact therewith. The draw bolt **50** is provided with a head **54** which is received within the enlarged portion **40** of the bore **38** at the flanged end of the main body portion **34**, the length of the head **54** being less than the length of the enlarged portion **40** of the bore **38** so as not to project beyond the corresponding end face of the main body portion **34**.

At least one and preferably a plurality of spring washers **56** are threaded on the draw bolt **50** and positioned between the head **54** of the draw bolt and the shoulder **58** formed at the junction of the bore **38** and the enlarged portion **40** thereof. The head **54** of the draw bolt **50** is provided with a plurality of peripheral serrations or notches **60**, as best indicated in Fig. 3, for the purpose of receiving a wrench with which to rotate the draw bolt. In practice after the nose **42** has been applied and locked against rotation by means of the dowel pin **48**, the draw bolt **50** is inserted into the bore and threaded into the opening **52** in the nose **42** and the draw bolt **50** is drawn up to such an extent as to place the spring washers **56** under a material tension but not to such an extent as to completely flatten such washers. The tension initially applied to the washer **56** in this manner, and of course while the ram **24** is cold, is sufficient to securely maintain the nose piece **42** in axial contact with the main body portion **34**. In service, however, the main body portion **34** will heat up faster than the draw bolt **50** and will be axially elongated to a greater extent than the draw bolt **50** for this reason. This difference in elongation between the main body portion **34** and the draw bolt **50** will be taken up by further springing of the washers **56** without subjecting the draw bolt **50** to any undue stresses. It will be appreciated that when the ram is thereafter cooled to room temperatures the spring washers **56** will act to restore the original force holding the nose **42** to the main body portion **34**. It will be understood from the above that were the head **54** of the draw bolt **50** to seat directly against the shoulder **58** without the inter-position of spring washers **56** or the like, the main body portion **34** might elongate to a sufficient extent to stretch the draw bolt **50** beyond its elastic limit and to permanently elongate it, under which circumstances as soon as the ram **24** was cooled down, a looseness would develop between the nose piece **42** and the main body portion **34**.

In order to prevent rotation of the draw bolt **50** and thereby prevent possible looseness from developing between the head **42** and main body portion **34** in service, the flanged end of the main body portion **34**, as best illustrated in Fig. 3, is formed to provide a groove or keyway **62** in a side wall of the enlarged portion **40** of the bore **38**, and in drawing up the draw bolt **50** the head **54** is turned so as to bring one of the slots **60** into registration with the keyway **62**, upon which a key **64** is driven into the keyway **62** and the aligned slot **60** to positively lock the draw bolt **50** against relative rotation with respect to the main body portion **34**.

Where the nose piece **42** becomes worn, scored or otherwise deformed in service to such an extent as to require replacement, all that is required is to remove the key **64**, thus permitting removal of the draw bolt **50** which automatically releases the nose piece **42** from the main body portion **34** and permits a new nose piece to be applied in its place. Particularly where the main body portion **34** is formed from a suitable material as hereinafter more fully described and is brought to the desired hardness, a number of different nose pieces **42** may be replaced on the rams without requiring any replacement or reservicing of the main body portion **34** itself. Also because the main body portion **34** and nose piece **42** are separable as described, each may be produced of a material especially adaptable to the work to be performed thereby, and independently hardened and tempered so as to obtain the best physical requirements of each, thus avoiding the disadvantages of the welded type of composite ram referred to above.

Because of the fact that the main body portion **34** is hollow it will be apparent that in the hardening step the liquid or air employed for chilling it will have access to the bore **38** as well as to the external surfaces. For this reason the material from which the main body portion **34** is made will be hardened to a materially greater uniformity than can be possible in a solid type of ram and the result is that the main body portion **34** may be hardened to a relatively high degree, namely, to 550 Brinell and higher without setting up such internal stresses in the material thereof as might endanger bending of the same under the circumstances above explained. In this connection it will be recalled that in solid rams it has been found that a hardness of 450 Brinell sets up such great internal stresses that the ram becomes permanently bent upon the occurrence of slight mis-alignments between the ram and cylinder. With the separate nose piece 42 which, when constructed of suitable material may be brought to a hardness of in the neighborhood of 600 Brinell, a completed ram is provided having the most desirable characteristics of a hard nose and a main body portion exhibiting maximum resistance to columnar stresses and at the same time highly resistant to both abrasion and wear.

One material suitable for forming the main body portion or shank 34 in accordance with the present invention to obtain the desired characteristics above stated is of the following analysis, it being understood that the usual inclusions of sulphur, phosphorus and/or other impurities may be present.

C	.48/.53
Mn	.60/.80
Si	1.50/1.75
Va	.10/.14
Mo	.35/.45
Fe	Balance

In constructing a main body portion or shank 34 from the above material the following constitutes the preferred steps of operation in its manufacture and heat treatment.

1. Forge
2. Normalize
3. Anneal 1475/1500° F.—187 Brinell.
4. Finish bore and rough turn O. D.
5. Oil quench 1550° F.—600 Brinell
6. Draw at 750° F.—550 Brinell
7. Draw flanged end at 1000° F.—450 Brinell
8. Finish turn or grind O. D.

A material of the following analysis may also be employed for the main body portion or shank 34.

C	.90/1.05
Mn	.20/ .30
Si	.20/ .30
Cr	.45/ .55
Fe	Balance

In constructing a main body portion or shank 34 from the above material the following constitutes the preferred steps of operation in its manufacture and heat treatment.

1. Forge
2. Normalize
3. Anneal 1500° F.—197 Brinell
4. Finish bore and rough turn O. D.
5. Water quench 1525° F.—650 Brinell
6. Draw at 600° F.—550 Brinell
7. Draw flanged end at 800° F.—450 Brinell
8. Finish turn or grind O. D.

A material suitable for the formation of the nose piece 42 may have the following analysis:

C	.30/ .40
Mn	.30/ .40
Si	1.00/1.75
Cr	4.00/6.00
Va	.40/ .50
Mo	1.25/2.50
Fe	Balance

In constructing a nose piece 42 from the above material the following constitutes the preferred steps of operation in its manufacture and heat treatment.

1. Forge
2. Normalize
3. Anneal 1650° F.—220 Brinell
4. Drill-thread-rough turn and face
5. Oil quench 1950° F.—600 Brinell
6. Draw at 1100/1150° F.—450 Brinell
7. Finish turn or grind and face.

A material of the following analysis may also be employed for the nose piece 42.

C	.35/ .42
Mn	.20/ .35
Si	.60/1.10
Cr	1.00/1.50
W	3.75/4.25
Va	.15/ .30
Fe	Balance

In constructing a nose piece 42 from the above material the following constitutes the preferred steps of operation in its manufacture and heat treatment.

1. Forge
2. Normalize
3. Anneal 1600° F.—220 Brinell
4. Drill-thread-rough turn and face
5. Oil quench 1950° F.—600 Brinell
6. Draw at 1000° F.—450 Brinell
7. Finish turn or grind and face.

A material for constructing the draw bolt 50 may have the following analysis.

C	.40/. 50
Mn	.25/ .35
Si	.25/ .35
Cr	1.40/1.50
W	1.60/1.75
Va	.25/ .30
Fe	Balance

In constructing a draw bolt 50 from the above material the following constitutes the preferred steps of operation in its manufacture and heat treatment.

1. Forge
2. Normalize
3. Anneal 1525° F.—207 Brinell
4. Thread and machine splines in bolt head

A material of the following analysis may also be employed for the draw bolt 50.

C	.35/ .40
Mn	.65/ .80
Si	.20/ .30
Cr	.90/1.10
Fe	Balance

In constructing a draw bolt 50 from the above material the following constitutes the preferred steps of operation in its manufacture and heat treatment.

1. Forge
2. Normalize
3. Anneal 1550° F.—187 Brinell
4. Thread and machine splines in bolt head

In the above examples it will be understood that in specifying the hardness of the main body portion 34 at 550 Brinell, the nose piece 42 at 450 Brinell, and the draw bolt 50 at 207 Brinell, the hardnesses stated are preferred and possible with the construction of the ram described and the materials specified for the various parts thereof. However, it is to be understood that where the same or other suitable materials are employed, the hardness of the main body portion 34 and nose piece 42 in particular, (the draw bolt not being so important) may vary above and below the limits of hardness specified, for instance, between 400 and 650 Brinell as determined by the particular material employed for these parts and/or the heat treatment to which they are subjected.

Formal changes may be made in the specific embodiment of the invention described without departing from the spirit or substance of the broad invention, the scope of which is commensurate with the appended claims.

What I claim is:

1. A ram for an extruding press or the like comprising a main body portion having an axial bore extending completely therethrough, a nose piece of the same cross-sectional contour and size as said main body portion seated against an end of said main body portion and closing said bore, means extending through said bore removably securing said nose piece and main body portion together, and yieldable means cooperating between the first mentioned means and said main body portion maintaining the effectiveness of the securing effect of said first mentioned means and guarding it against destructive forces due to elongation of said main body portion.

2. A ram for an extruding press or the like comprising a generally cylindrical hardened main body portion having a cylindrical axial bore therethrough of from one-quarter to one-sixth the diameter of said main body portion, and a solid hardened cylindrical nose piece of the same general diameter as said main body portion removably secured to one end of said main body portion.

3. A ram for an extruding press or the like comprising a generally cylindrical hardened main body portion having a cylindrical axial bore therethrough of from one-quarter to one-sixth the diameter of said main body portion, and a solid hardened cylindrical nose piece of the same general diameter as said main body portion and of no greater length than its diameter removably secured to one end of said main body portion.

4. A ram for an extruding press or the like comprising a main body portion and a nose piece removably secured to one end thereof, said main body portion having a central opening extending therethrough and being formed of a material of a hardness between 400 and 650 Brinell over the greater portion of its length.

5. A ram for an extruding press comprising a hollow main body portion having a hardness of between 400 and 650 Brinell over the greater portion of its length, a separate solid nose piece of the same general diameter as said main body portion applied to one end of said main body portion, said nose piece having a hardness of between 400 and 650 Brinell, and means removably securing said nose piece and main body portion together.

6. A ram for an extruding press comprising a hollow main body portion having a hardness of approximately 500 Brinell over the greater portion of its length, a separate solid nose piece of the same general diameter as said main body portion applied to one end of said main body portion, said nose piece having a hardness of approximately 450 Brinell, and means removably securing said nose piece and main body portion together.

7. A ram for an extruding press or the like comprising a generally cylindrical main body portion having a hardness of between 400 and 650 Brinell and having an axial bore extending therethrough of a diameter between one-quarter and one-sixth of the diameter of said main body portion, a separate and solid nose piece of the same diameter as said main body portion and of a hardness between 400 and 650 Brinell, and means removably securing said nose piece in concentric relation to one end of said main body portion.

8. A ram for an extruding press or the like comprising a main body portion and a separable nose portion removably secured thereto, said main body portion comprising a generally cylindrical member having an axial bore therethrough and formed of a material having a hardness between 400 and 650 Brinell and being free of excessive internal stresses when in free condition.

9. A ram for an extruding press or the like comprising a main body portion having an axial bore extending completely therethrough, a nose piece of the same cross-sectional contour and size as said main body portion seated against an end of said main body portion and closing said bore, a draw bolt extending through said bore and threaded into said nose piece removably securing said nose piece to said main body portion, means cooperating between said main body portion and said draw bolt locking them against relative rotation, and means cooperating between said nose piece and said main body portion locking them against relative rotation.

10. A ram for an extruding press or the like comprising a hollow main body portion and a separable nose portion, said portions having cooperating pilot and recess for maintaining the concentricity of said portions, and a draw bolt extending through the interior of said main body portion and cooperating with said nose portion to maintain said portions against inadvertent axial displacement.

11. A ram for an extruding press or the like comprising a generally cylindrical main body portion having a bore therethrough, a separable solid nose piece on one end of said main body portion, said bore being enlarged at that end of said main body portion opposite said nose piece to form a recess, a draw bolt extending through said bore for removably securing said nose piece and main body portion together, a head on said draw bolt received in said recess, said head having a groove in a side thereof, the side wall of said recess having a groove therein, and a key received in both of said grooves for locking said draw bolt against relative rotation with respect to said main body portion.

12. A ram for an extruding press or the like comprising a generally cylindrical main body portion having a bore therethrough, a separable solid nose piece on one end of said main body portion, said bore being enlarged at that end of said main body portion opposite said nose piece to form a recess, a draw bolt extending through said bore for removably securing said nose piece and main body portion together, a head on said draw bolt received in said recess, a spring washer received on said draw bolt and maintained under stress between said head and the bottom of said recess, said head having a groove in a side thereof, the side wall of said recess having a groove therein, and a key received in both of said grooves for locking said draw bolt against relative rotation with respect to said main body portion.

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