Jan. 24, 1961 R. E. CALE 2,968,976

HEADING DIE

Filed June 11, 1958 3 Sheets-Sheet 1

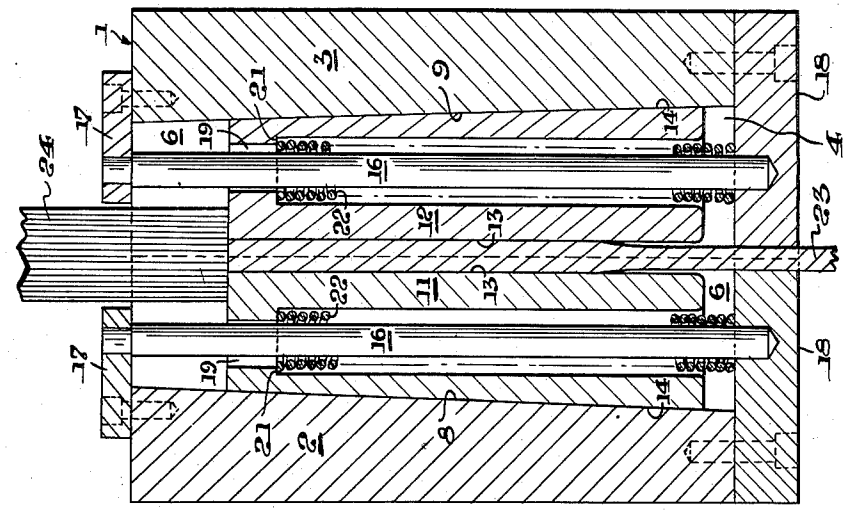


Fig. 3.

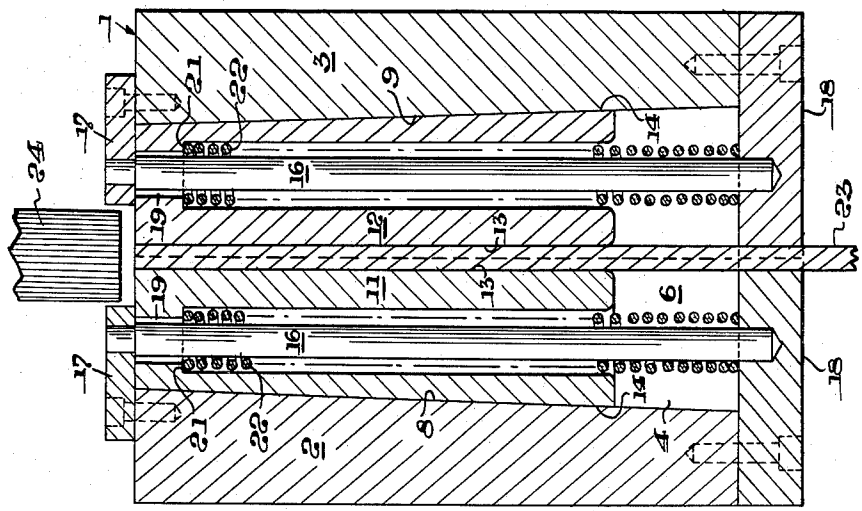


Fig. 1.

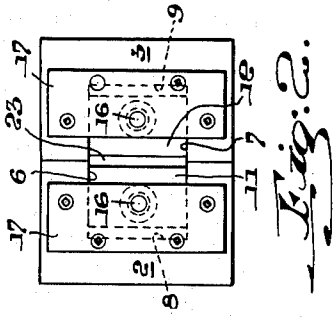


Fig. 2.

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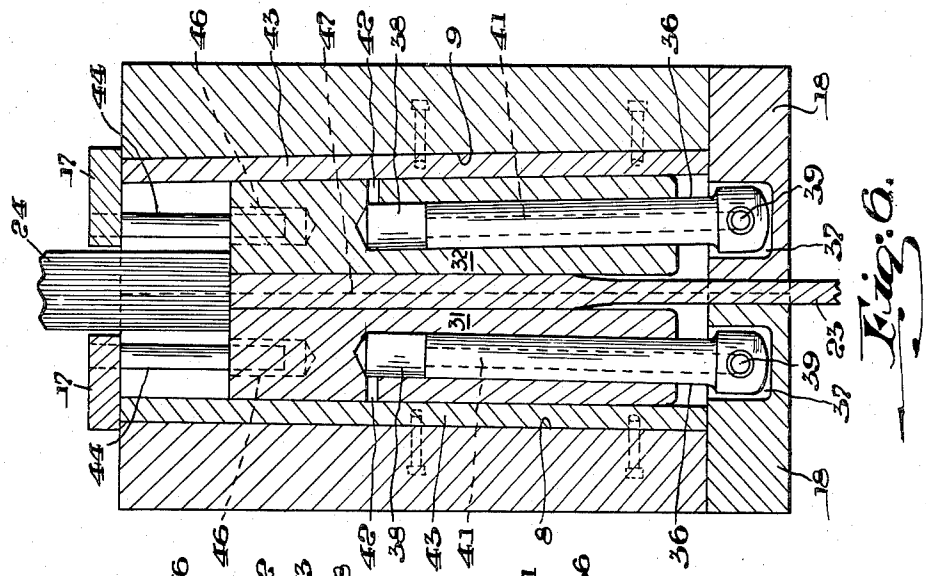


Fig. 6.

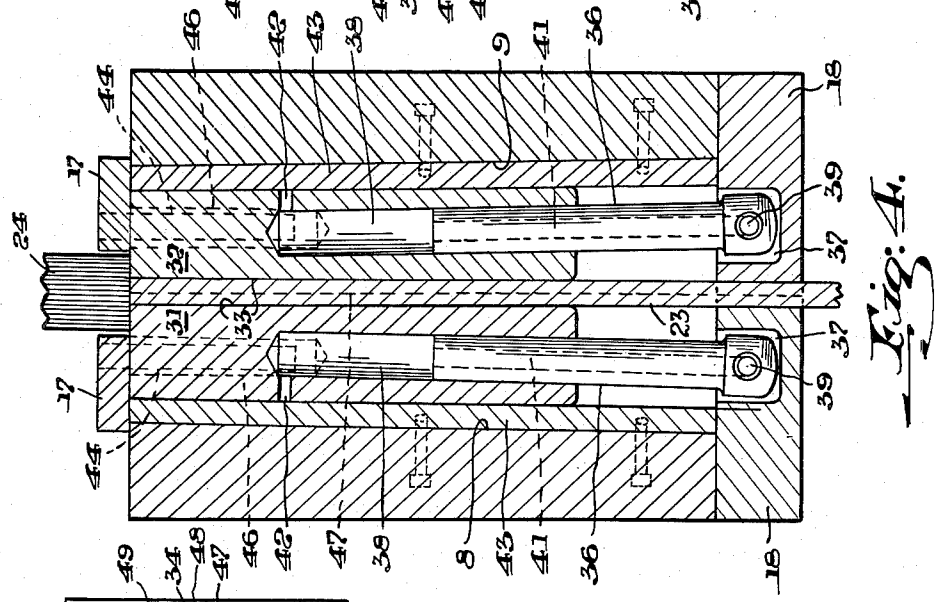


Fig. 4.

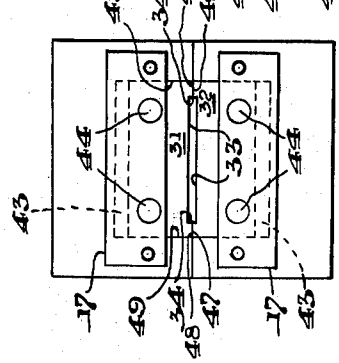


Fig. 5.

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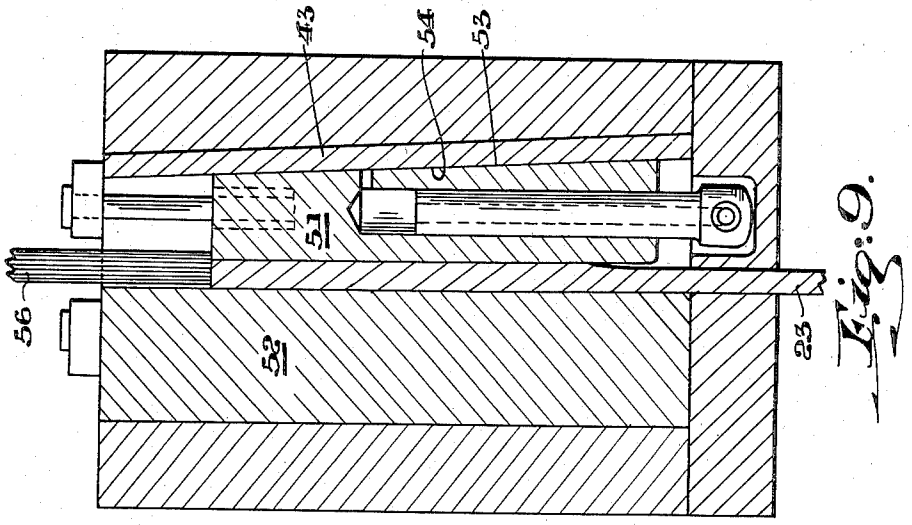


Fig. 9.

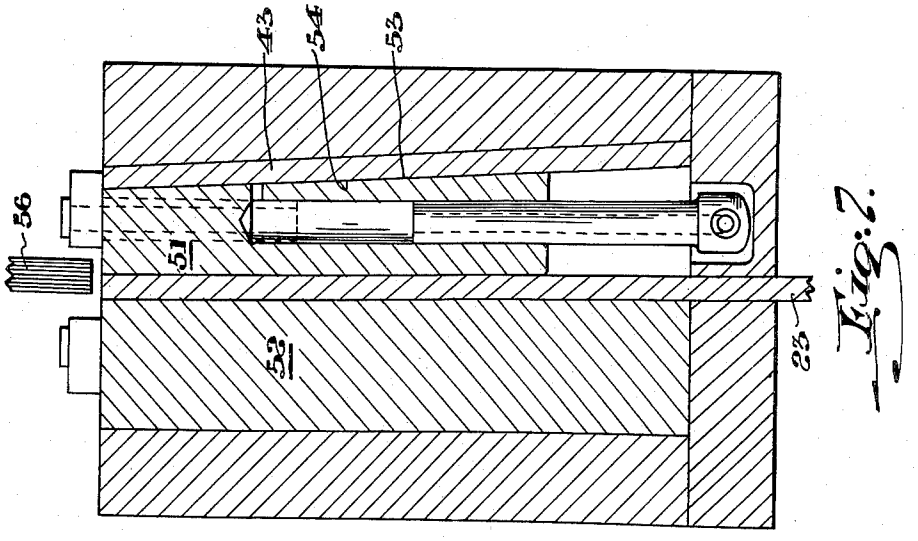


Fig. 7.

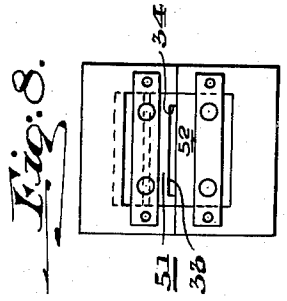


Fig. 8.

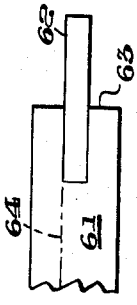


Fig. 10.

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HEADING DIE

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9 Claims. (Cl. 78—61)

This invention relates to a heading die for upsetting bar stock and the like; it is particularly useful in upsetting long portions of relatively wide, thin stock having a substantially rectangular cross section both before and after it is upset.

This application is a continuation-in-part of my copending application S.N. 628,042, filed December 13, 1956, for a Heading Die, which is now abandoned.

Conventional upsetting dies are provided with a die cavity (i.e., the space bounded by the working faces of the die) having a fixed cross section conforming to the desired cross section of the stock after it is upset, but greater than the initial cross section of the stock. Such dies are not suitable for upsetting long portions of relatively wide, thin stock. When a length of such stock at forging temperatures is subjected to the pressure of a header tool in a conventional die, there appears to be greater initial deformation of an intermediate portion of the stock, resulting in frictional engagement between that portion and a wall or walls of the die cavity. This engagement tends more or less to concentrate the upsetting pressure towards the header end of the stock (i.e., it resists the transmission of pressure beyond the point or points of engagement). In addition, there is greater longitudinal displacement of the stock at the header end of the die than at the opposite end, which is usually fixed, so that frictional resistance is concentrated at the header end. As a result, the header end of the stock tends to be more completely upset (often to the extent of jamming the die) than is the opposite end. The reverse, but equally unsatisfactory, effect is obtained if the header tool closes one end of the die and remains stationary, while upsetting pressure is applied to the other end of the stock.

It is accordingly among the objects of this invention to provide a heading die that will upset long portions of relatively wide, thin stock uniformly throughout the desired length and that will prevent the upset stock from jamming the die.

Other objects will be apparent from the following description of the invention and the accompanying drawings, in which

Fig. 1 is a horizontal section of the improved die, showing the initial position of the die parts before the stock is upset;

Fig. 2 is a reduced end elevation of the die of Fig. 1;

Fig. 3 is a horizontal section similar to Fig. 1, but showing the die parts in their final positions after the upsetting operation has been completed;

Fig. 4 is a horizontal section of a modified form of die, the parts thereof being in their initial position before the stock is upset;

Fig. 5 is a reduced end elevation of the modified die of Fig. 4;

Fig. 6 is a horizontal section of the modified die of Fig. 3, but showing the die parts in their final position after the upsetting operation has been completed;

Fig. 7 is a horizontal section of a second modified form of die, with the die parts in their initial position before the stock is upset;

Fig. 8 is a reduced end elevation of the die of Fig. 7;

Fig. 9 is a horizontal section of the die of Fig. 7, but showing the die parts in their final positions after the upsetting operation has been completed; and

Fig. 10 is a modified form of header tool that can be substituted for the header tool shown in the preceding figures.

In accordance with this invention, the upsetting die includes a die holder with a central recess therein extending longitudinally from front to back. At least one of two opposite walls of this recess is sloped outwardly from front to back. Within this recess is slidably retained a die block or die having a sliding face that engages the sloping inner wall of the recess and a die face opposite thereto for contacting the stock to be upset. The sliding face of the die slopes outwardly from front to back with the same slope as the wall it engages. A second die is disposed within the recess against the opposite wall with its die face opposed to but spaced from the die face of the first die. The second die may be fixedly or slidably disposed relative to the die holder; if slidably disposed, it may slide on an outwardly flaring slope of its engaging wall like the first die. The initial position of the sliding die or dies is near the front of the die cavity, where the die faces of the two dies will be spaced apart a minimum distance that is substantially equal to or slightly greater than the thickness of the stock before it is upset. The stock is inserted in the recess between the die faces. Pressure means, such as a header tool, upsets the stock and drives the sliding die or dies, during at least a portion of the upsetting operation, towards the back of the recess where the opposing die faces will be further apart and spaced from each other a distance equal to the desired upset thickness of the stock. In other words, the thickness of the die cavity itself between the opposing die faces is greater at the end of the upsetting operation than at the beginning.

Referring to the drawings, a die holder, generally indicated by the numeral **1**, is preferably made of two separable parts **2** and **3**, one of which is stationary and the other adapted to be reciprocated in conventional manner (not shown) to open and close the die. The die holder is generally disposed with its longitudinal axis horizontal, so that the two parts of the holder lie side by side. Each part has a central longitudinal channel extending from front to back (i.e., from top to bottom in Figs. 1 and 3) along the side that contacts the other part of the die holder. When the die holder is in its closed position, shown in the drawings, these combined channels form a central longitudinal recess **4** extending from front to back of the composite holder. Two opposite walls of this recess, preferably the top and bottom walls **6** and **7** (see Fig. 2), are parallel; but the other two walls **8** and **9** are sloped outwardly from front to back.

Two laterally spaced dies **11** and **12** are slidably mounted in the recess **4**. Each has an inner die face **13** that is opposed to but spaced from the corresponding face of the other die. Opposite its die face, each die has an outer sliding face **14**, which engages one of the sloping walls of the recess and is similarly sloped from front to back. The dies are loosely retained for movement lengthwise of the die holder by guide pins **16**, the ends of which are held by plates **17** and **18** secured to the front and back, respectively, of the die holder. These pins pass through holes **19** in the dies; and each hole is provided with a shoulder **21** near the front end of the die, against which presses one end of a coil spring **22** carried by the pin **16**. The other end of the spring rests against the back plate **18** of the die holder. These

springs force the dies to the front of the holder, their normal position, as shown in Fig. 1. Sufficient clearance is allowed between the sides of the hole **19** and the spring and pin to permit each die to move laterally outward when it is pushed toward the back of the die holder.

The die cavity, in which the upsetting occurs, is the space bounded by the opposed die faces **13** of the two sliding dies and the included parallel walls **6** and **7** of the die holder. In this embodiment, the initial cross section of this cavity conforms as nearly as practicable to the initial cross section of the stock that is to be upset, while the final cross section of the cavity conforms to the desired upset cross section of the stock.

In using the die of Figs. 1–3, the die holder is opened by separating its parts, and an end of bar stock **23**, which has been heated to forging temperature, is inserted between the dies. The die holder is then closed, so that the parts are in the position shown in Figs. 1 and 2, with the metal stock entirely filling the die cavity. The unheated portion of the stock is suitably held against lengthwise movement, either by the clamping action of the edges of the plates **18** at the back of the die holder, or by any other suitable means. A header tool **24** engages the end of the stock, and at the same time engages the front ends of the sliding dies. As the dies move back in their holder under the pressure of the header, the stock between them is upset a predetermined amount depending upon the angle of slope of the inner walls **8** and **9** of the recess and the distance through which the sliding dies travel. Throughout the upsetting operation, the wide sides of the stock are in substantially full contact with the die faces of the two sliding dies and are supported thereby, so that upsetting will be uniform throughout the desired length of stock. When the stock has been fully upset, the parts will be in the position shown in Fig. 3. The die holder is then opened, the upset blank removed from the die, and the sliding dies are returned under the urging of the springs to their normal front positions shown in Fig. 1.

In Figs. 4–6 is shown a modified form of heading die, which differs from the embodiment shown in Figs. 1–3 in the following respects: (1) the opposed sliding dies **31** and **32** (otherwise corresponding to dies **11** and **12** of Figs. 1–3) are channeled lengthwise, so that the bottoms **33** and the sides **34** of those channels define the initial die cavity and act as opposed pairs of die faces when upsetting stock; (2) the springs **22** of Figs. 1 and 3 for returning the sliding dies to their initial positions are replaced by pneumatic pistons **36** having one of their ends received in pockets **37** in back plate **18** and their other ends received in cylinder bores **38** of the sliding dies, so that the latter can be returned to their initial positions at the end of the upsetting operation by air pressure introduced from a source not shown through inlet ports **39** and hollow stems **41** of the pistons to the interior of the cylinder bore, the air escaping therefrom through outlet ports **42** in the wall of each sliding die; (3) a wear plate **43** is interposed between the sliding face of each of the dies **31** and **32** and the adjacent walls **8**, **9** of the die holder; and (4) guide pins **16** in Figs. 1–3 are replaced by guide pins **44** loosely received in oversized holes **46** in the ends of the sliding dies, with one end of each pin secured to front plate **17**.

Although the marginal edges **47** of the sliding dies in Figs. 4–6 will separate slightly as they are pushed towards the back of the recess (due to the outward flare of the sliding faces of the wear plate), it has been found that the stock extrudes little, if at all, into the space between those marginal edges. To the extent that it does extrude therein, the resulting fillet is not objectionable in many upsetting applications. It is an advantage of this structure that the stock does not come in contact with the intersections **48** of the relatively sliding edge surfaces **49** of the sliding dies and the walls **6** and **7** of the die holder, so that the stock cannot be smeared or extruded between those surfaces. Also, the pneumatic means for returning the sliding dies to their initial positions permits more positive action than is obtained with the springs of Figs. 1–3, and the constant stream of air discharged through the outlet ports **42** tends to maintain the engaging surfaces of the sliding dies and the wear plates free of dirt. The use of a wear plate obviously protects the walls of the die holder, and these plates can be renewed whenever they have become sufficiently worn.

A further modification is shown in Figs. 7–9, in which there is only one sliding die **51**, opposed by a stationary die **52**. The sliding die is the same as die **31** of Figs. 4–6 and is similarly mounted in the die holder, except that the slope of its sliding face **53** (and the complementary slope of the sliding face **54** of wear plate **43**) is twice that of the die and wear plate in Figs. 4 and 5, thereby obtaining with only one sliding die the same enlargement of the die cavity during the upsetting operation as is obtained with two opposed sliding dies in Figs. 4 and 5. The header tool **56** used with this embodiment is narrower than the tool **24** of Figs. 1 and 3, so that it will engage the end of the stock and the end of the sliding die **51**, but not the stationary die **52**.

It has been found that the embodiment of the heading die shown in Figs. 7–9 is a compromise between (1) conventional heading dies in which the die faces are parallel and fixed and frictional resistance is concentrated at the header end of the stock during the upsetting operation and (2) the embodiments shown in Figs. 1–6 in which the opposed sliding dies concentrate the frictional resistance (which is constantly relieved by the spreading of the dies) at the opposite end of the heated portion of the stock. In the modification of Figs. 7–9, the frictional resistance at the header end of the stock is concentrated on the side next to the stationary die; and this is offset by the increased frictional resistance at the other end, which is concentrated on the side next to the sliding die. In each case, the frictional resistance is constantly relieved by the widening of the die cavity during the upsetting operation. Also, the structure of Figs. 7–9 has the advantage that usually only one die need be changed when upsetting stock to different desired thicknesses.

In Fig. 10 is shown a modified form of header tool **61**, similar to the header tool shown in Figs. 1 and 4, except that there is fixed to its operating end a blade **62** thin enough to enter the space between the opposing die faces and partially upset the stock before the shoulders **63** of the header tool engage the sliding dies to continue the upsetting operation as previously described. When using this modified header tool, the initial thickness of the die cavity should be somewhat greater than the initial thickness of the stock to be upset, so as to provide enough room to upset the stock initially with the blade of the header tool before the sliding dies begin to move. A similarly modified header tool can also be used with the heading die shown in Figs. 7–9, in which the blade is flush with one side of the tool so that there will be only a single shoulder **63** to engage the single sliding die and no shoulder adjacent the fixed die. Such a header tool would look like that portion of Fig. 10 below the broken line **64**.

It has been found for many applications that this modified header tool, with the blade projecting beyond the tool shoulders (or shoulder) a distance equal to less than about one-half of the desired reduction in length of the stock during the upsetting operation, will partially upset the stock before the sliding dies (or die) begin to move (to this extent the upsetting operation is conventional), but that jamming is prevented and uniform upsetting is obtained by the sliding of the dies (or die) during the final portion of the upsetting operation.

It is among the advantages of this invention that rela-

tively thin, wide bar stock, as herein illustrated, may be upset uniformly over a considerable length. It is not essential, though it may be preferable, that the narrow edges of the stock initially contact the parallel walls of the die holder (or the sides of the channeled dies), since there is not the same tendency for the stock to be upset unevenly on those edges. It will be understood that the die faces of the dies need not be plane or parallel surfaces, as herein illustrated; that any one or more of the modified features of Figs. 4–6 can be used with the heading die of Figs. 1–3; and that the stationary die of Figs. 7–9 can be substituted for one of the sliding dies of Figs. 1–3. It will also be understood that, if both the opposed dies are sliding dies, one of them may slide on an outwardly flaring surface (as does die **11** in Fig. 1) and the other may slide on a non-sloping surface (such as die **12** in Fig. 1 but with the surfaces **9** and **14** parallel to the die face **13**).

According to the provisions of the Patent Statutes, I have explained the principle of my invention and have illustrated and described what I now consider to represent its best embodiment. However, I desire to have it understood that, within the scope of the appended claims, the invention may be practiced otherwise than as specifically illustrated and described.

I claim:

1. An upsetting die for upsetting a length of wide, thin stock, comprising a die holder having a central recess therein extending from front to back, the recess having a side wall sloping outwardly from front to back, a first die slidably disposed within the recess for movement from front to back therein, the die having a sliding face that engages the sloping side wall of the recess and an opposite face provided with a longitudinally extending channel, the outer edges of which are spaced from the walls of the die holder, a second die disposed within the recess and having a die face opposed to the channel in the first die, the bottom and side walls of the channel in the first die and the die face of the second die defining a die cavity for receiving the stock and for supporting it during the upsetting operation in spaced relation to the walls of the die holder, and pressure means for applying longitudinal pressure on a length of stock inserted in the die cavity and for moving the first die longitudinally towards the back of the die holder during at least a portion of the upsetting operation.

2. A device according to claim 1, in which the bottom and side walls of the channel in the first die and the die face of the second die define a laterally and vertically closed die cavity when both dies are at the front of the recess.

3. A device according to claim 1, in which the second die remains fixed relative to the die holder during the upsetting operation.

4. A device according to claim 1, in which the die face of the second die is formed by the bottom and side walls of a longitudinally extending channel opposed to and having substantially the same depth and width as the channel in the first die.

5. A device according to claim 1, in which the second die is slidably received within the recess and is moved along with the first die by the pressure means towards the back of the recess during at least a portion of the upsetting operation.

6. A device according to claim 1, in which the pressure means includes a header tool having a shoulder portion and a blade portion extending beyond the shoulder portion, the blade portion being adapted to engage the end of the stock adjacent the front of the die holder for partially upsetting the stock and the shoulder portion being adapted to engage the front end of the first die after the stock has been partially upset.

7. A device according to claim 1, in which the die cavity defined by the dies when both dies are at the front of the recess has a cross section substantially equal to that of the stock before it is upset, and in which the first die moves towards the back of the recess during substantially the entire upsetting operation.

8. A device according to claim 1 that also includes means for returning the first die from the back to the front of the recess in the die holder, said means comprising a pneumatic cylinder in the first die, a hollow piston received in the cylinder with its free end mounted on the die holder, and a source of fluid under pressure connected to the cylinder through the hollow piston.

9. An upsetting die for upsetting a length of relatively wide, thin stock, comprising a die holder having a central recess therein extending longitudinally from front to back, the recess having two opposite side walls sloping outwardly front to back, a pair of dies slidably retained for longitudinal reciprocation within the recess, each die having a sliding face engaging a sloping side wall of the recess and an opposite face provided with a longitudinally extending channel opposed to and matching the channel in the other die, the outer edges of the channel in each die being spaced from the walls of the die holder and the bottoms and side walls of the opposed channels defining a laterally and vertically closed die cavity when the dies are at the front of the recess, means for normally retaining the dies at the front of the recess, means for rigidly holding the stock to be upset with a length thereof extending into the die cavity and means for exerting longitudinal pressure on the stock to upset it and for exerting longitudinal pressure on the dies during at least a portion of the upsetting operation to slide the dies towards the back of the recess.

References Cited in the file of this patent

UNITED STATES PATENTS

291,098	Sellers	Jan. 1, 1884
415,402	Aiken	Nov. 19, 1889
415,403	Aiken	Nov. 19, 1889
1,402,919	Carlson	Jan. 10, 1922
1,458,294	Hook	June 12, 1923
2,138,867	Lanto	Dec. 6, 1938
2,327,117	Lorant	Aug. 17, 1943
2,490,954	Flick	Dec. 13, 1949