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AIR HYDRAULIC PRESS

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2 Sheets-Sheet 2

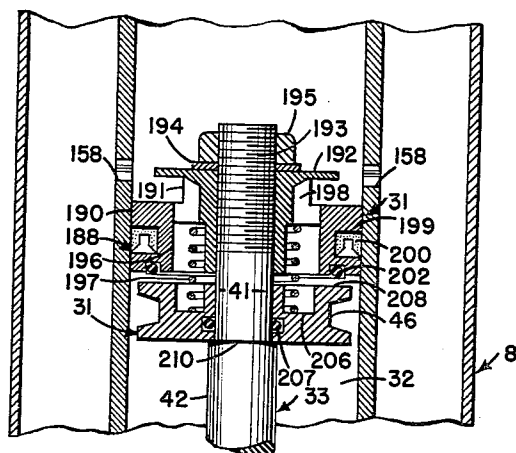


Fig. 2

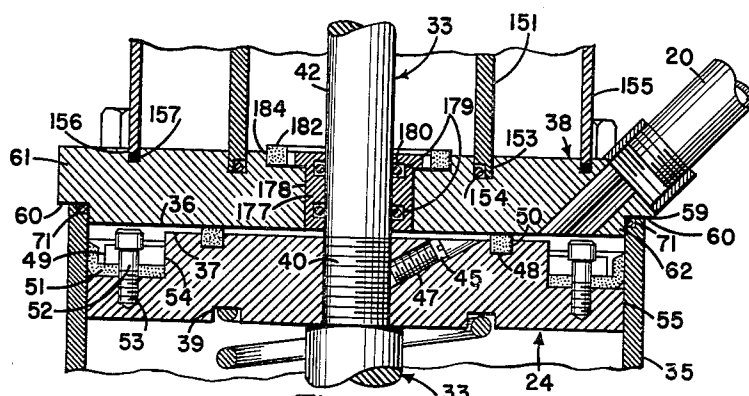


Fig. 3

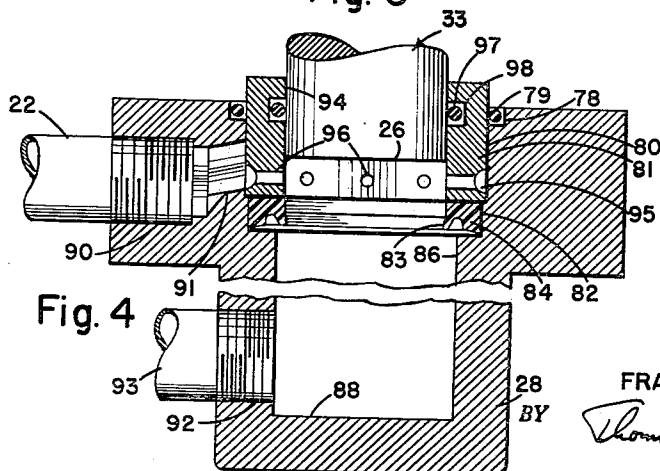


Fig. 4

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## AIR HYDRAULIC PRESS

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13 Claims. (Cl. 83—571)

My invention relates to a hydraulic press for punching sheet material, particularly sheet metals.

It will be understood that said invention has broader application than mere use for punching sheet metals; however, the embodiment disclosed by my accompanying drawings and description make reference only to use as a machine for punching sheet metals.

Hydraulic presses in the past have had predetermined stroke lengths. Therefore, irrespective of what gauge material was to be punched by the hydraulic presses heretofore known in the art, any given punch traveled a given distance into the die complementing the punch.

Of course, among the old art, there were adjustable stroke punches enabling manual adjustment of the stroke. My invention abrogates the necessity of such a manual adjustment; is self adjusting; and the stroke of the punch varies proportionately to the thickness of the material being perforated.

In the prior art pneumatic and hydraulic punches, not infrequently, would double trip. This handicap is overcome in my invention. Once the punch has stopped, it is necessary to release the pressure which drives the punch before said punch is retractable and after the pressure has been released, it would not be possible to make a second stroke without a second application of pressure on the means driving the punch.

An object of my invention is to provide a machine for punching sheet metal which stops automatically and instantaneously after it has penetrated the material being punched.

My invention contemplates a self-adjusting apparatus; the punching stroke varies proportionately to the thickness of the material being punched.

Another object of my invention is to provide an apparatus with a valve which is the means for stopping the punch or ram nose; said valve is sensitive to the increase in speed of the punch occurring instantaneously after it has penetrated the metal.

My invention contemplates a method for placing sheet metal between a punch and a die complementing said punch, applying pressure to the punch, penetrating said sheet metal with said punch, stopping said punch instantaneously after said penetration by means sensitive to the increased speed of said punch occurring after penetration and retracting said punch from the metal.

Another object of my invention is to provide a punch machine which causes less wear on the punch and the die into which the punch passes after penetration of the metal.

My invention contemplates a punch mechanism which will not double trip.

Also, an object of my invention is to provide a more economically operable machine for punching sheet metal than was known in the prior art. One economic factor in the operation is the conservation of compressed air resulting from the automatic stopping thereof instantaneously after penetration of the metal being worked upon.

Other objects and advantages of my invention will be particularly set forth in the claims and will be apparent from the following description of this embodiment of my invention, when taken in connection with the accompanying drawings, in which:

FIG. 1 is a side elevational view with parts broken away and in section;

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FIG. 2 is an enlarged view of the inertia valve of FIG. 1 with parts broken away and in section;

FIG. 3 is an enlarged view of the main piston 24 and surrounding parts as shown in FIG. 1; and

FIG. 4 is an enlarged sectional view taken on the line 4—4 in FIG. 1 and looking in the direction indicated by the arrows.

Referring to FIG. 1, this embodiment of my invention comprises an oil reservoir generally indicated by the numeral 8, an open fluid circuit or hydraulic system generally indicated by the numeral 10, a compressed air circuit generally indicated by the numeral 12, a closed fluid circuit or hydraulic system generally indicated by the numeral 14, and a punch or ram generally indicated by the numeral 16.

This embodiment of my invention is operated by means of compressed air in the compressed air system or circuit 12. The compressed air is controlled by a foot operated valve (not shown) which permits air to flow through a pipe 20 to a cylinder 35. Prior to the introduction of compressed air into pipe 20, the closed hydraulic system 14 is connected by a by-pass pipe 22 to the open hydraulic system 10; hence, both hydraulic systems are combined into one open hydraulic system before compressed air is introduced into cylinder 35 by way of pipe 20 (FIG. 1).

When compressed air is introduced into cylinder 35, a piston, generally indicated by the numeral 24, is driven downwardly resulting in a corresponding downwardly motion of a piston or driving end 26 of a piston rod, generally indicated by the numeral 33. When piston 26 is in the position shown in FIGS. 1 and 4, both hydraulic systems are united into one open system, but once piston 26 descends below, in this case, eight holes 96, the oil in a cylinder 28 below piston 26 and the remaining oil throughout the hydraulic system 14 is converted to oil under pressure, and there no longer is any operative connection between said oil under pressure and the open hydraulic system 10. There is then a corresponding downward movement of a piston 30 (FIG. 1) transmitted by hydraulic system 14 which controls punch 16.

During the penetration of the sheet metal being punched by punch or ram 16, there is a decrease in the speed of said punch. Conversely there is an increase in the speed of said ram the instant that punch 16 has completed penetration of the metal. This increase in the speed of punch 16 is transmitted by means of the closed hydraulic system 14 to piston 26 causing a sharp descent in said piston which causes an inertia valve, generally indicated by the numeral 31, to close. When valve 31 closes, the oil below said valve becomes oil under pressure which instantaneously locks rod 33, including piston 26, in a stationary position. The instant that piston 26 stops there is a corresponding stoppage of ram punch rod 16 transmitted by the closed hydraulic system 14.

The above described operation of stopping punch rod 16 transpires instantaneously after punch 16 has penetrated the sheet metal. This enables the punch to be instantaneously stopped once it has penetrated the sheet metal. The inertia valve 31 and punch 16 remain in a locked position so long as air pressure is applied to piston 24. This is a safety feature of my invention over and above the prior art; the punch 16 cannot "double trip." The punch 16 may be retracted from the sheet metal, after it has penetrated said sheet metal by releasing the air pressure in pipe 20; the tension of a coil spring 34 returns piston 24 to its original position shown in FIG. 1. Thus, I have described briefly one entire stroke of the apparatus for punching or piercing sheet metal.

In the foregoing paragraphs, I have described generally what will hereinafter be described in detail. Referring to FIG. 1, compressed air enters a cylinder 35

through pipe 20. The flow of compressed air through pipe 20 is controlled by means of a foot-operated valve (not shown) operated by an individual working the press. The compressed air acts upon a bottom surface 36 of a top cover plate 38 of cylinder 35 and upon a top surface 37 of piston 24. The compressed air drives piston 24 downwardly in opposition to the pressure of coil spring 34, the top of which is seated in a slot 39 cut circumferentially in the bottom surface of piston 24.

Referring to FIG. 3, piston 24 is threaded on piston rod 33 at 40 and locked in a stationary position by means of a lock screw 45 threaded into a hole 47 cut diagonally through piston 24. The lock screw 45 engages shaft 33.

Referring to FIG. 1, piston rod 33 consists of three portions, 41, 42 and 44. The top portion 41 of rod 33 is the smallest in diameter and is the portion upon which is mounted the inertia valve 31. Portion 42 of rod 33 is larger in diameter than portion 41 and the shoulder thereof serves to support an inertia float 46 of valve 31. Portion 44 of rod 33 is the largest in diameter and the top shoulder thereof lends support to piston 24. The bottom or piston surface 26 of rod 33 constitutes a piston.

Referring to FIG. 3, an annular resilient cushion 48 is seated in a groove 50 cut concentrically with rod 33 in surface 37 of piston 24. The cushion serves as a spacer between surfaces 36 and 37, preventing surface 37 from engaging surface 36 when the pressure of coil spring 34 returns piston 24 to its position shown in FIG. 1 after the compressed air is released by the foot-operated valve (not shown). An annular seal 51 is secured to piston 24 by means of a ring 49 bolted to piston 24 by bolts 52 threaded into piston 24 at 53. The seal and bolts reside in a groove 54 cut circumferentially of piston 24. Seal 51 serves to prevent any compressed air from escaping around the outer circumference 55 of piston 24 as compressed air is applied to piston 24.

Referring to FIG. 1, as piston 24 makes its descending stroke, spring 34 is compressed thereunder and the air inside cylinder 35 below piston 24 escapes through four vents 56 cut in cylinder 35. The bottom of coil spring 34 is seated in a groove 57 cut circumferentially in a bottom cover plate 58 engaging the bottom of cylinder 35.

Cover plates 38 and 58 are held in rigid engagement with the top and bottom, respectively, of cylinder 35 by means of four tie-rods 66, which transverse four holes 68 bored in a square portion 59 of cover plate 58 and in a square portion 61 of cover plate 38, these holes being exterior of cylinder 35. A nut 70 is threaded onto each end of tie-rods 66 locking cover plates 38 and 58 to cylinder 35. Both cover plates 38 and 58 have projected circular portions 62 and 63, respectively, engaging the interior surface of cylinder 35 at either end thereof. Two seals or gaskets 71 are seated in recesses cut circumferentially in the interior surface of cylinder 35 at the top and bottom end thereof.

Referring to FIG. 1, cylinder 28 has a flange 73 on the upper end rigidly connected to bottom cover plate 58 by four bolts 74. Bolts 74 transverse four holes (not shown) cut through flange 73 and are threaded into cover plate 58. Referring to FIG. 4, cylinder 28 has a bore consisting of four different size diameter portions; a largest diameter portion 78 retains a seal 79; a somewhat smaller diameter portion 80 retains a bronze bushing 81; a portion 82 somewhat smaller in diameter than 80 retains a packing ring 84; and a smallest diameter portion 86 which extends longitudinally through the greater part of cylinder 28 from portion 84 to a bottom surface 88 of cylinder 28. Seal 79 prevents any leakage of oil between cover plate 58 and flange 73. Pipe 22 is threaded into flange 73 at 90. A hole 91 intersects bore 80 at one end and joins pipe 22 at its other end. As stated above, when piston 24 is in the position shown

in FIGS. 1 and 4, oil flows freely between hydraulic systems 10 and 14; the oil flows from pipe 22 through hole 91 into bushing 81 seated in bore 80, and from there into bore 86. Bronze bushing 81 has a bore 94 complementing piston 26 and a semi-circular groove 95 cut around the exterior circumference thereof. Eight holes 96 cut radially through bushing 81 extend from groove 95 to bore 94. The oil flowing through hole 91 flows around groove 95, through holes 96 and into bore 86 when driving end 26 of rod 33 is in the position shown in FIG. 4.

A seal 97 seated in a groove 98, cut circumferentially in the interior sidewall of bushing 81, engages piston rod 33 as said portion travels through bushing 81; this prevents oil leakage below the point of engagement. A recess 99 (FIG. 1) bored in the bottom of cover plate 58 engages bushing 94 and holds the bushing in a stationary position.

As piston 24 descends in cylinder 35, piston end 26 of shaft 33 is driven downward past holes 96, at which position the oil can no longer flow from holes 96 to bore 86 of cylinder 28. The oil in hydraulic system 14 becomes oil under pressure. Packing ring 84 has a flap 83 that engages the entire circumference of shaft 33 during the downward stroke thereof. Flap 83 prevents any oil from leaking upwardly between flap 83 and shaft 33 and this guarantees a closed fluid system.

A female threaded hole 92 bored transversely in the lower end of cylinder 28 is adapted for receiving a threaded pipe 93. The oil flows into pipe 93 from cylinder 28 and is discharged from pipe 93 into cylinder 100 (FIG. 1). The downward motion of piston 26 is transmitted by the oil through pipe 93 to piston 30 traveling in cylinder 100. In turn, ram 16 penetrates the sheet metal to be punched.

Referring to FIG. 1, an air vent 104 in the side wall of cylinder 100 permits the escape of air below piston 30 as it descends in response to the oil pressure. The descent of piston 30 is in opposition to the pressure of a coil spring 106. An O-packing ring 105 seated in a groove 107 cut circumferentially in piston 30 prevents the leakage of oil below piston 30.

A top cover plate 102 and a bottom cover plate 108 are rigidly secured to either end of cylinder 100 by means of four tie-rods 110. The lower portions of these tie-rods are threaded into holes 111 bored in bottom cover plate 108; the upper portion of tie-rods 110 transverse holes 112 bored in top cover plate 102. A nut 113 threaded on the upper portion of each rod 110 locks the rods in a stationary position. This combination of parts locks cylinder 100, cover plate 102, and cover plate 108 into one unit. Cover plate 102 has a circular projection 114 complementing the bore of cylinder 100 which engages the interior sidewall of cylinder 100. Bottom cover plate 108 has a similar projection 115 engaging the interior sidewall of cylinder 100 at the bottom thereof. A seal 116 seals the top cover plate to cylinder 100.

A bronze bushing 117 fitting into a hole 118 bored in the center of bottom cover plate 108 aligns punch 16.

Punch 16 comprises two parts. The first part is a solid shaft consisting of three portions: a top portion 121, a middle portion 126 and a bottom portion 128. The top portion 121 is the smallest diameter portion which complements and transverses a hole 119, bored in the center of piston 30. Portion 121 has a threaded section 120 on which is threaded a nut 122 serving as a locking means for locking the punch 16 to piston 30. A gasket 123 seated in a groove 124 between the punch 16 and the cylinder 30 prevents any oil leakage therebetween. The middle portion 126 is longer and somewhat larger in diameter than portion 121 and transverses bushing 117. The third portion 128 is somewhat smaller in diameter than portion 126. A hole 130 bored transversely to the horizontal axis in portion 128 is designed for receiving a ball 131 and a

coil spring 132 exerting pressure against ball 131 radially from the center of portion 128.

The second part of punch 16 is a ram nose 133 having a hole 134 bored transversely therein complementing portion 128 of the first part of punch 16. A groove 29 cut circumferentially in the interior surface of ram nose 133 is adapted for receiving ball 131. Ball 131 fitting into groove 129 serves as a means for locking ram nose 133 to portion 128.

It will be observed that above cover plate 102 is a ram adjustment means generally indicated by the numeral 135, comprising an adjustable shaft 136 which engages portion 121 of punch 16 and a support 137 into which shaft 136 is threaded at 140. When shaft 136 is threaded up or down at 140 by means of a wrench (not shown) being applied to a square-shaped end 138 of shaft 136 by an individual desiring such adjustment, punch 16 is moved correspondingly. The purpose of the punch adjustment means 135 is to permit the use of various size ram noses 133 with punch 16. Hence, regardless of size, the ram nose utilized may be adjusted to a given distance from the metal to be punched. Support 137 is securely anchored to top cover plate 102 by means of four bolts 144 which transverse holes 146 bored in a flange 142 of support 137 and are threaded into receiving holes 148 in the top cover plate 102.

A bottom threaded portion 150 of tie rods 110 is secured to the supporting surface (not shown) for the sheet metal being penetrated. Four lock nuts 149 are threaded onto threaded portion 150 in order to lock the punch 16 in a rigid position with respect to the supporting surface.

During the penetration of the sheet metal by ram nose 133, there is a decrease in speed of the ram nose and punch due to the resistance to penetration offered by the metal. Instantaneously, after completion of the penetration, there is a sharp increase in the rate of speed of descent of said ram nose and piston 30, resulting from the build up of pressure during said penetration, and by means of hydraulic system 14, there is a resultant sharp increase in descent of piston 26. As will be described more in detail hereafter, the sharp decline of piston 26 causes inertia valve 31 to close and instantaneously lock all moving parts, including the ram nose, in a stopped position.

Referring to FIG. 3, inertia valve 31 travels in a cylinder 151. The lower end of cylinder 151 is seated in a groove or slot 153 cut in the top surface of cover plate 38 and sealed therein by packing ring 154. A cylinder 155 surrounds cylinder 151 and the lower end thereof is seated in a complementing groove or slot 156 cut in the top surface of the top cover plate 38 and hermetically sealed therein by a seal 157. Referring to FIG. 1, there are eight vent holes 158 in the sidewall of cylinder 151 permitting free passage of oil from cylinder 151 to 155 and vice versa; cylinder 155 merely serves as an oil reservoir.

A top cover plate 159 engages both cylinders 151 and 155. Cover plate 159 has a recess 160 cut circumferentially around the outermost edge thereof, which engages the upper end of cylinder 155. Cover plate 159 is hermetically sealed within cylinder 155 by means of an O-packing seal 161 seater in a groove cut circumferentially in the recess 160. A circular hole cut substantially in the center of cover plate 159 is designed for receiving a lid or plug 164. A hole 165 cut through the center of lid 164 is threaded to receive a breather cap 166. The purpose of breather cap 166 is to permit the intake and exhaust of air when there is decrease or increase in the volume of oil in cylinders 151 and 155. The lid 164 is removable to enable the user to add oil to hydraulic system 10. An O-packing ring 167 residing in a groove cut circumferentially in lid 164 frictionally secures lid 164 within the center hole of cover plate 159. Cover plate 159 engages the uppermost end of cylinder 151 at 168.

The lower ends of four tie-rods 170 are threaded into holes 171 of cover plate 38. The upper ends thereof transverse four holes 172 of cover plate 159 and have

threaded thereon nuts 173 which lock cover plate 159 and cylinders 151 and 155 to cover plate 38.

Referring to FIG. 3, portion 42 of shaft 33 is aligned by a bronze bushing 177 seated in a hole 178 bored in cover plate 38. Two grooves 179 cut circumferentially in the interior surface of bushing 177 retain two O-packing seals 180 which engage portion 42 of shaft 33. A cushion 182 made of a resilient material surrounding bushing 177 is seated in a circular recess 184 in the top surface of cover plate 38. Cushion 182 prevents valve 31 from engaging cover plate 38.

Referring to FIG. 2, inertia valve 31 comprises inertia float 46 having a hole bored through the center thereof complementing top portion 41 of shaft 33, and an inertia valve top generally indicated by the numeral 188.

Valve top 188 comprises three distinct portions 190, 191 and 192. Portion 190 is circular in configuration and complements the bore of cylinder 151 in which it travels. Portion 191 is somewhat smaller in diameter than portion 190. Portion 192 is a flange constituting the uppermost portion of the valve top 188. Valve top 188 is rigidly mounted on portion 41 of shaft 33 by means of threads 193 at the upper end of shaft 33 on which valve top 188 is threaded. A washer 194 is secured in a frictionally engaging position with valve top 188 by a lock nut 195 threaded onto the upper portion of shaft 33. A coil spring 197 is seated in a groove 196 cut circumferentially in valve top 188. Six holes 198 cut equi-distant around the circumference of the valve top 188 are angular in configuration when viewed in a sectional view of valve top 188 as shown in FIG. 2. These holes are cut partially out of portion 191 and partially out of portion 190; holes 198 open into groove 196. There is a circumferential groove or slot 199 cut substantially in the center of the exterior circumference of portion 190 of valve top 188. An inverted U-shaped resilient seal 200 fits within hole 199 and prevents the leakage of oil from below valve top 188 to above the valve top when valve 31 is closed. A seal 202 seated in a groove cut circumferentially in the lower surface of valve top 188 engages inertia float 46 when valve 31 is in a closed position.

Inertia float 46 is slidably mounted on portion 41 of shaft 33 and is held at a predetermined spaced relationship to valve top 188 by means of spring 197. Spring 197 is seated in a groove 206, cut circumferentially in inertia float 46. An O-packing seal 207 engaging portion 41 of shaft 33 is seated in a groove, cut circumferentially in inertia float 46. When float 46 is held in spaced relationship to valve top 188, the lower surface of the float engages the upper end 210 of portion 42 of shaft 33.

In operation, valve 31 travels downwardly with shaft 33 during the time that ram 16 is driven downwardly, with the spaced relationship between float 46 and valve top 188 being maintained by spring 197. As valve 31 makes its descent, oil travels around the circumference of float 46 which is somewhat smaller in diameter than cylinder 151, then passes over the top of float 46, enters groove 196, and is discharged through holes 198. Thus, there is free passage of oil from below valve 31 to above valve 31 during the descending strokes of shaft 33 and ram 16. However, instantly after ram 16 has completely penetrated the sheet metal being worked on, there is a very rapid descent of valve top 188 equal to that of shaft 33. This rapid descent of valve top 188 is of sufficient force to overcome the pressure of spring 197 and seal 202 engages a top surface 208 of float 46. The instant that float 46 engages seal 202, the float and valve top 188 are locked together, stopping the flow of oil through valve top 188. The oil below valve 31 becomes oil under pressure, stopping and locking valve 31 and shaft 33 in stationary positions. The "stopping" and "locking" is transmitted by closed hydraulic system 14 to ram 16, preventing further descent of ram 16 after penetration of the metal being punched.

The "stopping" and "locking" reaction above described,

from the time penetration has been completed until the time that ram 16 is stopped, transpires instantaneously. Thus, ram 16 is locked in a stationary position instantly after it has perforated the sheet metal being worked upon as a direct result of completion of the perforating step. Ram 16 remains in a locked position until the air pressure in pipe 20 is released by the foot-operated valve (not shown). When the compressed air is released out of pipe 20, the pressure of coil spring 34 (FIG. 1) is sufficient to drive piston 24 upwardly and overcome the locking force created between seal 202 and the top surface 203 of float 46. As shaft 33 is driven upwardly, the float 46 and valve top 188 are returned to their respective spaced positions by the pressure of spring 197.

The nut 195 may be threaded upward on threads 193, in order to release the frictional contact between washer 194 and valve top 188. Thereafter valve top 188 may be threaded either up or down on threads 193 as a means for modifying the spaced relationship between float 46 and valve top 188. At the completion of this adjustment, the nut 195 may be threaded downwardly until washer 194 again frictionally engages valve top 186 and said valve top is locked in a selected stationary position. This adjustment provides a means for varying the time it takes for the ram nose 133 to come to a complete stop after it has perforated the sheet metal being worked upon. Whenever this adjustment is desirable, it is quite easily accomplished by removing plug 164 and making the above described adjustment within the confines of cylinder 151 and thereafter replacing the plug.

While I have shown and described the preferred form of mechanism of my invention, it will be apparent that various changes and modifications may be made therein, particularly in the form and relation of parts, without departing from the spirit of my invention as set forth in the appended claims.

I claim:

1. Apparatus for punching sheet material comprising, in combination, a punch, a closed fluid system effective to control said punch, a normally open fluid system, a valve mounted to slide in said open fluid system, said valve having an open position in which said open fluid system remains open and a closed position in which said open fluid system is closed, control means interconnecting said closed fluid system and said valve for moving said punch and valve substantially simultaneously, said valve being responsive to a selected increase in the rate of descent of said punch thereby to close and lock said punch and control means against further motion.

2. Apparatus in accordance with claim 1 in which said valve comprises a valve top having at least one opening extending axially therethrough, a float adapted to close said valve top opening and means for normally spacing said float from said valve top to enable fluid in said open fluid system to pass through said opening and for permitting said float to close said opening when there is an increase in speed resulting from said punch penetrating the material.

3. Apparatus in accordance with claim 2 including means for retracting said punch and withdrawing said float from said valve top after stopping and locking of said punch against motion.

4. An apparatus for punching sheet material comprising, in combination, a rod, a driving piston rigidly connected to said rod, means for applying pressure to said piston, a closed hydraulic system, a second piston at one end of said rod and constituting the driving end of said closed hydraulic system, a third piston driven by said closed hydraulic system, a punch rigidly connected to the third piston, said punch penetrating sheet material to be punched thereby when driven by the third piston, valve means rigidly mounted on said rod, an open hydraulic system, said valve means traveling in said open hydraulic system, said valve means being responsive to a selected increase in the speed of said rod for closing said open

hydraulic system to lock said valve means against further travel in a stopped position, there being said selected increase in the speed of the punch after penetration of said material sufficient to close said open hydraulic system, thereby instantaneously locking said valve means and punch in said stopped position, and a means for retracting said punch after it has stopped.

5. An apparatus for punching sheet material comprising, in combination, a punch, fluid means for moving said punch to penetrate material to be punched, an open fluid circuit, and normally open fluid controlled valve means movable with said punch in said open fluid circuit, said valve means being responsive to an increase in speed of the punch occurring after it has penetrated the material for instantaneously closing said open fluid circuit and locking said punch against motion.

6. Apparatus in accordance with claim 5 including means for adjusting the valve means to close in response to a selected increase in speed.

7. Apparatus in accordance with claim 5 in which said valve means comprises a valve top having at least one opening extending axially therethrough, a float adapted to close said valve top opening and means for normally spacing said float from said valve top to enable fluid in said open fluid circuit to pass through said opening and for permitting said float to close said opening when there is an increase in speed resulting from said punch penetrating the material.

8. An apparatus for punching sheet material comprising, in combination, punch means; fluid controlled means for moving said punch to sever a portion of the sheet material placed under said punch means and for stopping said punch; an open fluid system; and stopping means movable with and connected to one of the other said means, said stopping means being within said open fluid system and actuated by an increase in speed of the punch occurring at the instant the punch breaks through said material for closing said open fluid system to lock said punch means against further movement.

9. Apparatus in accordance with claim 8 in which the punch moving means and stopping means comprise, a rod, means connected to said rod by which said rod is normally controlled, a closed fluid system, a first piston at one end of said rod thereby constituting the driving end of said closed fluid system, a second piston, said closed fluid system transmitting pressure from the first piston to said second piston, the second piston in turn being connected to and driving the punch, a normally open valve mounted on said rod, the valve traveling in said open fluid system and being adapted to close said open fluid system and means for closing said valve when there is an increased descending speed of said rod resulting from penetration of the material thereby creating a second closed fluid system which instantaneously locks said punch in a stopped position.

10. Apparatus in accordance with claim 8 including means for retracting said punch after it has stopped.

11. An apparatus for punching sheet material comprising, in combination, a punch, a closed hydraulic system in power transmitting relationship with said punch, pressure means for applying pressure to the closed hydraulic system enabling said punch to penetrate the material to be punched thereby, an open hydraulic system, and valve means movable with and connected to said pressure means, said valve means traveling in said open hydraulic system, said valve means being responsive to a selected increase in the speed of said pressure means for closing said open hydraulic system to lock said valve and punch against further travel, said punch having an increased speed after it has penetrated said material sufficient to actuate said valve means, thereby to close said open hydraulic system.

12. Apparatus in accordance with claim 11 in which said valve comprises a valve top having at least one opening extending axially therethrough, a float adapted to close said valve top opening thereby closing said open fluid

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system and means for normally spacing said float from said valve top to enable fluid in said open fluid system to pass through said opening for permitting said float to close said opening when there is an increase in speed resulting from said punch penetrating the material.

13. An apparatus in accordance with claim 11 in which the pressure means comprises a rod on which said valve is mounted, a driving piston rigidly connected to said rod, pneumatic means for driving said piston, a driven piston

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at one end of said rod which constitutes a part of and transmits pressure to said closed hydraulic system.

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