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Strandell

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[54] **PUNCHING APPARATUS**

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[52] **U.S. Cl.** **83/160,** 83/562, 83/563, 83/621, 83/623, 83/685, 83/688, 83/698

[51] **Int. Cl.** **B26d 7/06**

[58] **Field of Search** 83/30, 160, 167, 83/563, 562, 553, 621, 652, 682, 684, 685, 701, 698, 688

[56] **References Cited**

UNITED STATES PATENTS

2,411,399	11/1946	Walpole	83/621 X
3,568,554	3/1971	Wiechec	83/621 X
3,227,022	1/1966	Evans et al.	83/623 X
2,518,433	8/1950	Friedman	83/160
1,428,174	9/1922	Luther	83/621 X

FOREIGN PATENTS OR APPLICATIONS

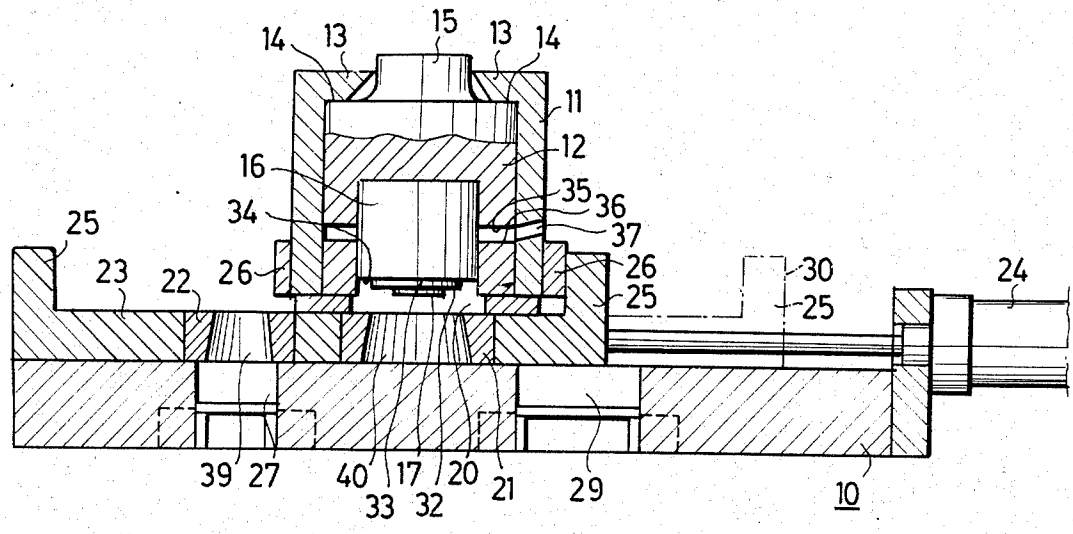
3,185	10/1868	Great Britain	83/553

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Assistant Examiner—W. D. Bray
Attorney—Stevens, Davis, Miller & Mosher

[57] **ABSTRACT**

A punching apparatus having a punch holder rigidly supporting two punches which at least partially overlap each other, and dies co-acting with their respective punch, at least one of the dies being movable away from its position in which it cooperates with its respective punch, while said punch objects into a perforation made in a workpiece by the same.

4 Claims, 5 Drawing Figures



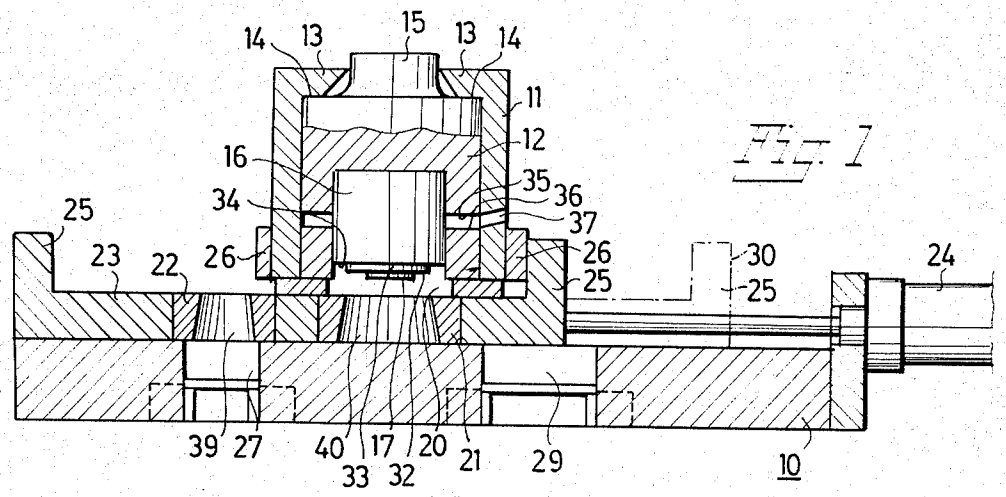

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Fig. 1

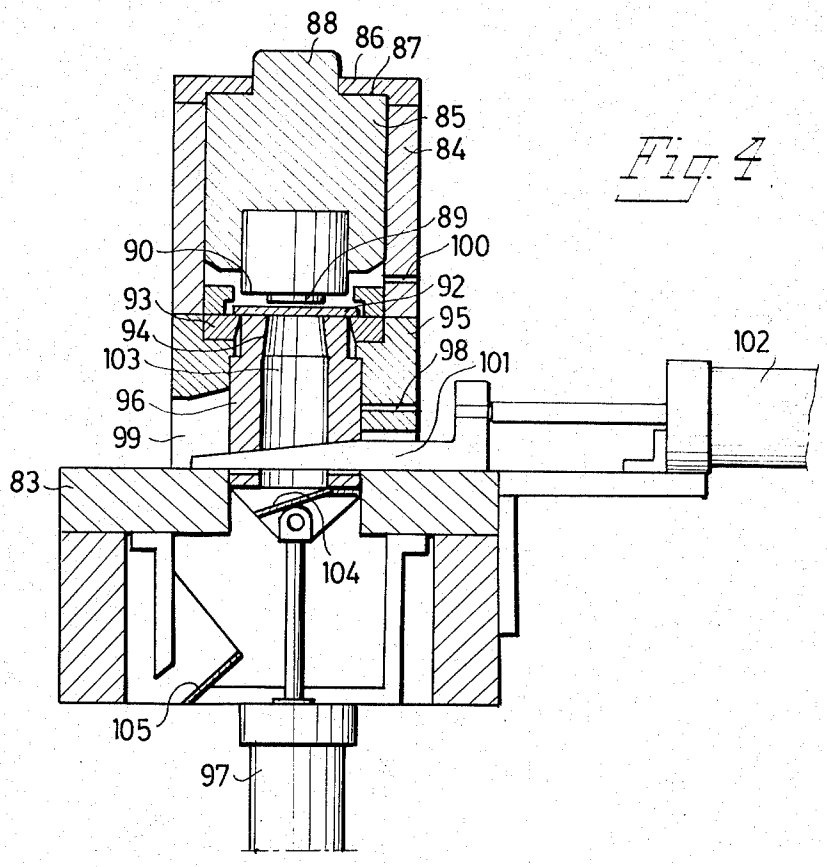

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Fig. 4

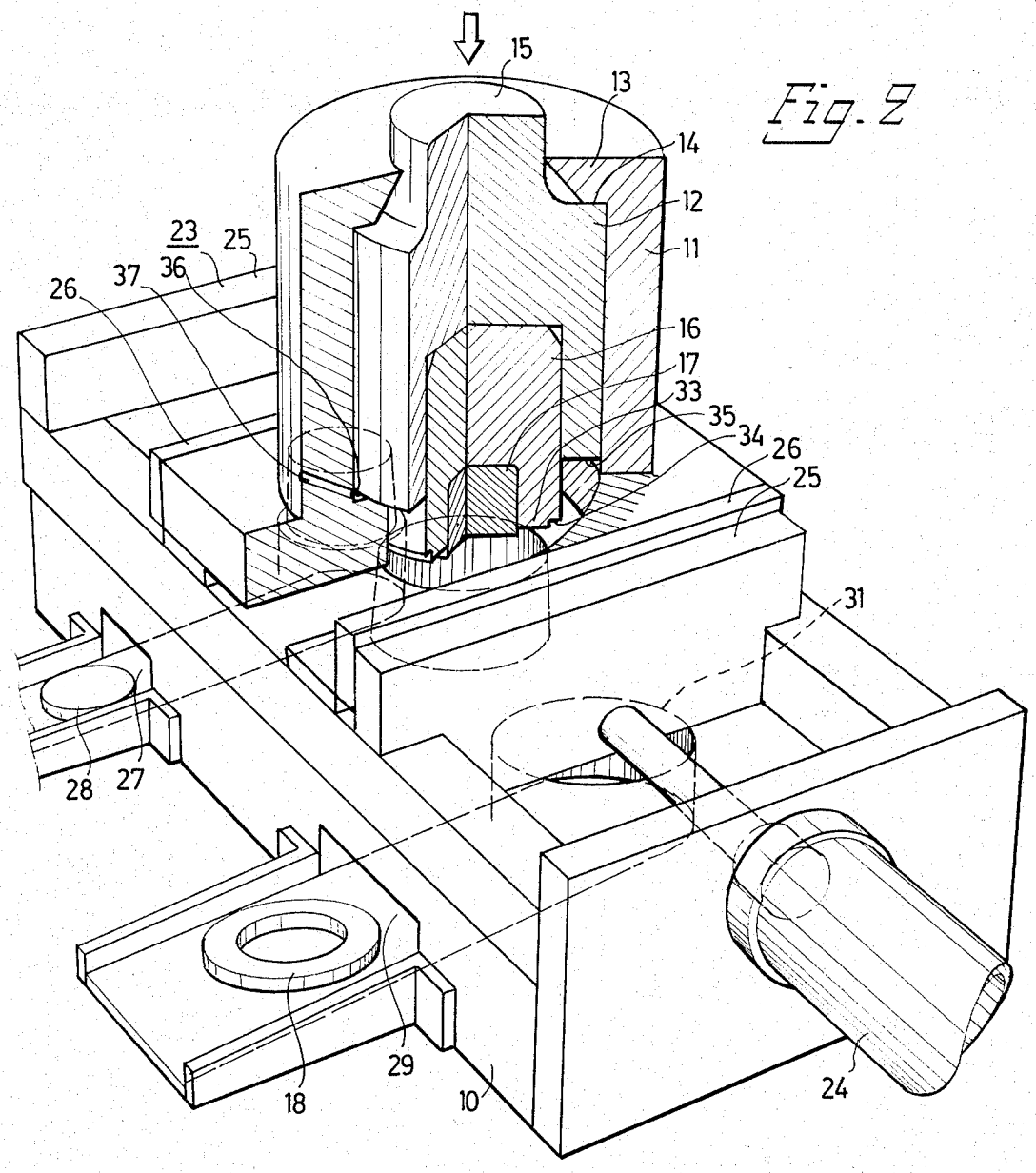


Fig. 2

Fig. 3

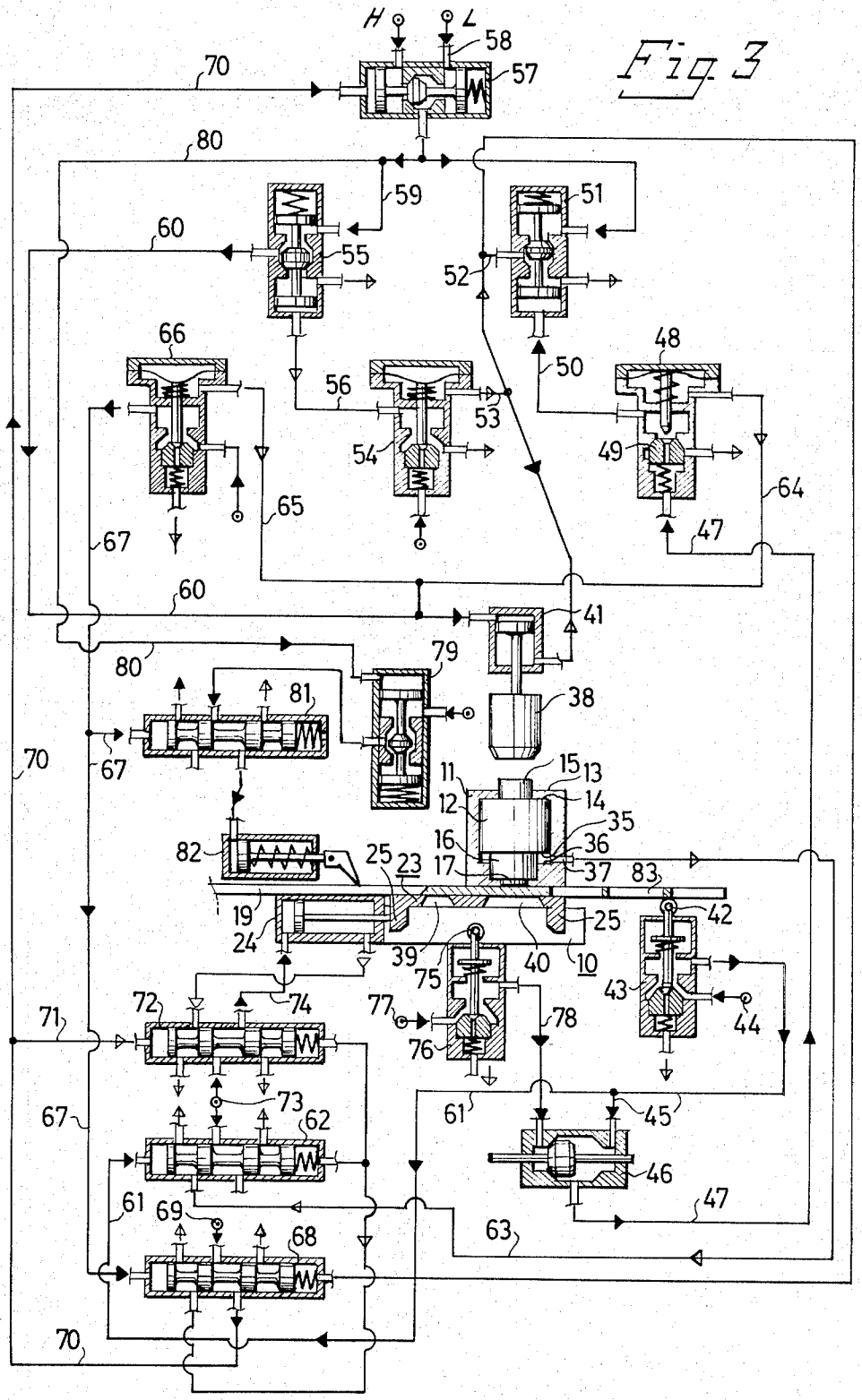
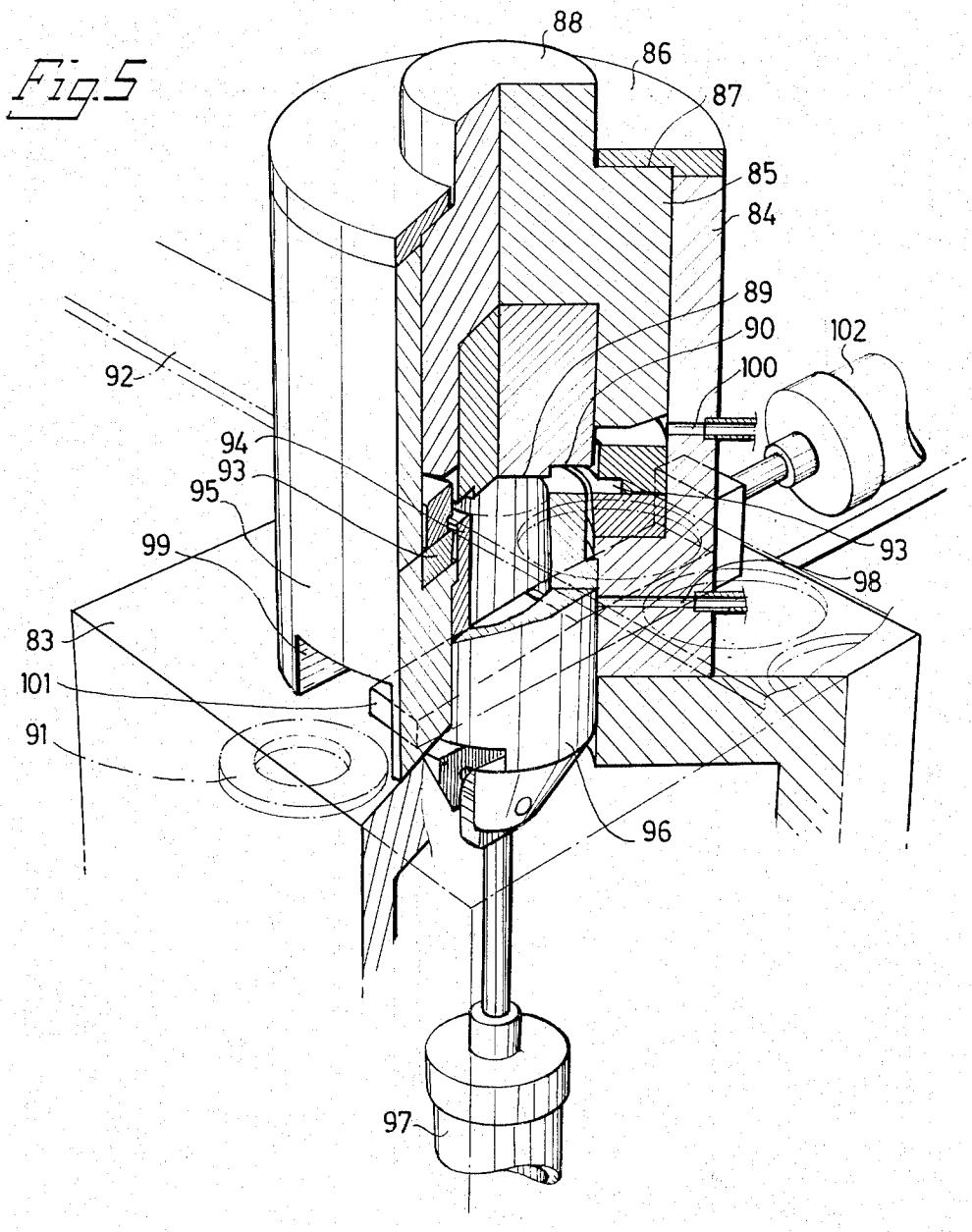

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Fig.5



PUNCHING APPARATUS

The present invention relates to an apparatus for punching elements from a flat workpiece, including a punch holder which is capable of moving towards and away from the workpiece and which is rigidly connected to at least two punches, an actuating means for delivering to the punch holder impact forces having sufficient energy to carry out each punching operation, punch dies arranged to co-act with the punches, and means for arresting movement of the punch holder immediately after an element has been punched free from the workpiece.

The object of the invention is to provide a novel and improved punching apparatus of the aforedescribed type which is of simple and inexpensive construction and by means of which elements of a complicated configuration can be punched from a workpiece with precision.

In accordance with the invention, the novel apparatus is characterized in that at least one first punch for making a first perforation in the workpiece is located, when projected onto the workpiece, at least partially within the surface of projection of a second punch for free-punching the elements from the workpiece and extends in the direction of the working stroke of the punch holder beyond the free-punching punch, in that a means is provided for temporarily arresting the movement of the punch holder immediately after the first perforation is made in the workpiece, and in that at least the die associated with the first punch is capable of being moved away from its co-acting position with the first punch means while the first punch projects into a perforation which it has made in the workpiece. As previously mentioned, the precision with which the elements are punched out by means of an apparatus constructed in accordance with the invention is high. Moreover, the problem of removing punched waste material and punched elements can be solved in a very simple manner, and the need of detent means etc., which complicate and increase the price of conventional punching apparatus, is eliminated.

The invention will now be described in more detail with reference to two embodiments thereof illustrated in the accompanying drawing, further features of the invention being discussed in conjunction therewith.

FIG. 1 is a diagrammatic view in vertical section of a first punching apparatus according to the invention.

FIG. 2 is a diagrammatic view in perspective of an apparatus which coincides in all essential details with the apparatus of FIG. 1.

FIG. 3 illustrates diagrammatically an arrangement for automatic operation of the apparatus illustrated in FIGS. 1 or 2.

FIG. 4 is a diagrammatic view in vertical section of a second punching apparatus according to the invention.

FIG. 5 is a diagrammatic view in perspective of an apparatus which coincides in all essential details with the apparatus of FIG. 4.

In FIGS. 1–3 the reference numeral 10 identifies a table which supports a casing 11 in which a punch holder 12 is mounted for reciprocating movement towards and away from the upper surface of the table 10. The casing 11 is provided at the top thereof with an upper wall portion 13 which, by engagement with a shoulder 14 on the punch holder 12, restricts upward

movement of the holder 12. Formed in the wall portion 13 is an opening through which projects a part 15 of the punch holder 12, the part 15 presenting a portion of reduced cross section. Two punches 16, 17, which are preferably detachable in respect of each other and of the punch holder 12, are rigidly connected to the lower end of the punch holder 12, while the operative portions of the punches 16, 17 of the illustrated example are coaxial with each other and have circular cross section, which are of different diameters for punching ring washer-like elements 18 from a flat workpiece.

The punching apparatus is also provided with a horizontal, through passing passage 20, through which the workpiece can be advanced with the punch means 16, 17 located above the workpiece and either one of two punch dies 21, 22 located beneath the workpiece for cooperation with the punch means. The dies 21, 22 are arranged on a slide 23 which is reciprocatingly movable along the table 10 and actuated by means of a pneumatic pressure cylinder 24 attached to the table. The ends of the slide 23 are provided with abutment surfaces 25 which, by engaging corresponding, suitably adjustable or exchangeable abutment surfaces 26 on the casing 11, are adapted to stop the slide in a position at which the die 21 is located opposite and beneath the punch 16 and the die 22 is located opposite and above a downwardly sloping discharge chute 27 formed in the table 10 for rounds 28 punched from the workpiece by means of punch 17, or in a position where the die 22 is located opposite and beneath the punch 17 and the die 21 is located opposite and above a downwardly sloping discharge chute 29 formed in the table 10 and intended to receive the elements 18. This latter position is indicated by means of broken lines 30 and 31 in FIGS. 1 and 2 respectively.

For the purpose of obtaining clean and true cut surfaces on the rounds 28 and elements 18, the punches 16, 17 are arranged to enter the workpiece a distance which preferably corresponds to only a small part of the thickness of the workpiece, and the punches 16, 17 are stopped immediately after a round 28 or an element 18 has been punched free from the workpiece. Subsequent to free-punching a round 28, the punch 17 is stopped temporarily by engagement between the upper side of the workpiece and the lower surface 32 of the punch 16. For this purpose, the punch 17 is caused to project beyond the punch 16 by an amount which is at least substantially equal to the shortest distance which the punch 17 must enter the workpiece 19 in order to cause a round 28 to be punched free therefrom, while the die 22 in its co-acting position with the punch 17 prevents, by abutment of the workpiece with the surface 32 of the punch 16, an element 18 from being punched free from the workpiece by means of the punch 16.

As illustrated in FIGS. 1 and 2, when the cross sectional area of the effective portion 33 of the punch 16 intended for free-punching elements 18 is smaller than the punch 16 in general, the punch 16 as the punch 17, can be stopped after free-punching an element 18 by engagement between the upper side of the workpiece and the surface 34 of the punch 16. To this end, the portion 33 is caused to project beyond the punch 16 in general by an amount which is at least substantially equal to the smallest distance which the punch 16 must enter the workpiece 19 in order to free-punch an element 18. The punch 16, however, can also be stopped

by engagement between the lower side **35** of the punch holder **12** and an internal shoulder **36** on the casing **11.**

Raising of the punch holder **12** subsequent to punching out an element **18** is effected by compressed air which is passed by means of a line **37** between the surface **35** and the shoulder **36.**

When punching out elements by means of the punching apparatus illustrated in FIGS. **1–3,** a workpiece **19** is fed into the passage **20** and the slide **23** is set in a position such that the die **22** is located beneath and in register with the punch means **17.** An impact tool **38** (FIG. **3**), whose weight is preferably large in relation to the weight of the punch holder **12,** is caused to impart to the tool holder **12** sufficient energy to punch out a round **28.** The round **28** falls down into the cavity **39** of the die **22** and rests against the upper surface of the table **10.** With the punch extending into the perforation thus formed, the slide **23** is moved with the aid of the pressure cylinder **24** to the position in which the die **21** co-acts with the punch **16** and in which the die **22** is located above and in register with the discharge chute **27,** so that the round punched from the workpiece passes out through the chute **27** and down into a collecting container (not shown). By then effecting a new working stroke with the tool **38,** the punch holder **12** is imparted energy sufficient to free-punch an element **18** from the workpiece **19,** the element **18** falling down into a cavity **40** of the die **21** to rest against the upper surface of the table **10.** When the energy required to punch a round **28** differs from that required to free-punch an element **18,** the requisite energy can be supplied by means of two different impact tools, or alternatively by varying the impact energy of the impact tool, for example by operating the impact tool with a pneumatic piston cylinder assembly **41** (FIG. **3**) and by applying a different air pressure in the assembly **41** to punch out a round **28** than that applied to free-punch an element **18.** Subsequent to free-punching an element **18,** the punch holder **12** is lifted by feeding air through the line **37** until contact is established between the upper wall **13** of the casing **11** and the abutment surface **25** on the punch holder, whereupon the slide **23** is so adjusted that the die **22** is located in register with and beneath the punch **17,** the element **18** located in the cavity **40** of the die **21** falling down into the inclined chute **27** and sliding out into a collecting container (not shown). Subsequent to feeding the workpiece **19** a distance in the passage **20** corresponding to the diameter of the element **18,** the working cycle described above can be repeated for punching out another element **18.**

FIG. **3** illustrates a block diagram of a system for automatically operating in accordance with the above the punching apparatus illustrated in any of FIGS. **1–2** and in FIG. **3.** For the purpose of illustrating the mode of operation of the automatic actuation system more clearly, the punching apparatus is illustrated differently to the apparatus of FIGS. **1** and **2.** For example, the abutment surfaces **25** of the slide of the apparatus of FIG. **3** are directed downwardly, with the slide reciprocatingly movable in the longitudinal direction of the workpiece **19.**

In the embodiment illustrated in FIG. **3,** the workpiece **19** is fed towards an arm **42** which transmits a pulse to a valve **43,** which thereupon opens to allow air under pressure from a line **44** to pass through said valve. The air under pressure passes, via a line **45,** over a switch valve **46** and a line **47** to a diaphragm valve **48** and via a valve body **49** and a line **50** to a valve **51,** which opens to communicate with a line **52,** which evacuates air from the negative side of the impact cylinder **41.** In this way there is obtained a pressure drop in a line **53,** whereupon the diaphragm of a diaphragm valve **54** is reversed and the valve is opened to evacuate a valve **55,** via a line **56.** The valve **55** opens for compressed air L of relatively low pressure arriving from a valve **57** via lines **58, 59** and **60** to the plus side of the impact cylinder **41,** and the impact tool **38** makes a stroke with a relatively small amount of energy and punches a round **28** (FIG. **2**) from the workpiece. (The slide **23** of the embodiment illustrated in FIG. **3** has already been reset to free-punch an element **18**).

At the same time, the valve **43** via the line **45** and a line **61,** transmits a pulse to a valve **62** which opens a line **63,** which evacuates the casing **11** of the punching apparatus of air so that the punch holder **12** falls down against the workpiece **19** before the first punching stroke is effected. When the impact cylinder **41** passes to its lower position, a drop in pressure occurs in lines **64** and **65** leading to the valve **48** and to a diaphragm valve **66** respectively, whereupon the diaphragms of the valves are reversed and the valves reset.

The valve **51** is now evacuated of air via the line **50,** the valve **51** being reset by a spring arranged therein. The valve **66** opens to allow compressed air to pass via a line **67** to a valve **68,** which allows compressed air to pass through the lines **69, 70** and **71** to the valve **57,** which is reset and opens so that compressed air H of relatively high pressure can pass therethrough, and also to a valve **72.** The pulse passing through the line **71** resets the valve **72,** which passes compressed air to the cylinder **24** via lines **73** and **74,** thereby changing the position of the slide **23.** When moving, the slide **23** actuates an arm **75** of a valve **76,** compressed air being fed from a line **77,** via a line **78,** to the switch valve **46,** which through the line **47** repeats the activation cycle via the diaphragm valve **48,** to cause a new stroke to be effected which this time has a higher energy. The punch **16** then punches an element **18** from the workpiece **19.** At the same time, the high pressure air passes to a valve **79** via a line **80,** which valve then opens to permit compressed air to flow to and through a valve **81,** which has been reset by the pressure in the line **67.** The valve **43** is actuated and opens to evacuate the valve **62** of air, the valve being reset, whereupon compressed air is then able to lift the punch holder **12.** The material feed means indicated by the reference numeral **82** now executes a stroke, whereupon an opening **83** formed in the workpiece **19** by free-punching an element **18** releases the arm **42** of the valve **43** and the process is repeated.

The embodiments of the punching apparatus according to the invention illustrated in FIGS. **4** and **5** coincide in many details with the punching apparatus illustrated in FIGS. **1–3.** Thus, there is shown in FIGS. **4** and **5** a table **83** which carries a casing **84** having a punch holder **85** mounted therein for movement in a direction towards and away from the supper surface of the table **83.** The casing **84** is provided at the top thereof with an upper wall **86** which, by engagement with an abutment surface **87** on the punch holder **85** restricts movement of the latter in an upward direction. Disposed in the wall **86** is an opening through which protrudes a part **88** of the punch holder **85,** the part **88** having a reduced cross section. A punch body, which

is preferably detachable in relation to the punch holder, is rigidly connected to the lower end of the punch holder **85**, the effective parts **89** and **90** of the punch body in the illustrated example being coaxial with each other and having a circular cross sectional shape but different diameters for punching round details **91** from a flat workpiece **92.**

The punching apparatus is provided with a horizontal, through-passing passage (FIG. **5**), through which the workpiece **92** can be advanced with the punch parts **89, 90** located above the workpiece, and two dies **93** and **94** cooperating with the punch parts and located beneath the workpiece. The punch die **93** is fixedly connected with a lower portion **95** of the casing **84,** while the punch die **94** has a downwardly projecting extension **96** mounted for movement in the portion **95.** The punch die **94** is capable of being moved vertically by means of a piston-cylinder assembly **97** attached to the table **83** via a bracket structure, the die **94** moving vertically between a position (FIGS. **4** and **5**) determined by abutment surfaces on the casing portion **95** and the extension **96** for cooperation with the punch part **89,** and a lower position in which the upper side of the punch die is located immediately beneath an air line **98** for ejecting punched elements **91** through an opening **99** in the casing portion **95** into a collecting container (not shown). The punch holder **85** is stopped when the punch components **89** and **90** have penetrated a predetermined distance into the workpiece **92,** in a manner described with reference to the apparatus of FIGS. **1–3,** and an air line **100** serves to introduce compressed air for lifting the punch holder until contact is established between the shoulder **87** and the wall **86,** in the manner described with reference to FIGS. **1–3.**

For the purpose of supporting the punch die **94** in its raised position, there is arranged a support wedge **101** which is capable of sliding on the upper surface of the table **83** which is capable of being inserted by means of a piston cylinder **102** mounted on the table **83** into a transversely extending recess in the extension **96,** and is withdrawable from the recess to enable the die **94** to be lowered.

Thus, the only difference between the mode of operation of the punching apparatus illustrated in FIGS. **4** and **5** and the mode of operation of the apparatus illustrated in FIGS. **1–3** resides in the fact that the punch die **94,** subsequent to a round being punched out of the workpiece by means of the punch part **89** and subsequent to withdrawing the support wedge **101,** is moved downwardly, while the punch die **93** is constantly located in a position in which it cooperates with the punch part **90.** The punch die **94** and its extension **96** are of hollow construction, as illustrated in FIGS. **4** and **5,** the rounds punched from the workpiece falling down into the cavity **103,** from where they are passed, via a plate **104** and a chute **105,** into a collecting container (not shown).

Although the punching apparatus have been described in the aforegoing with reference to the punching of round washers, it will be understood that elements of a different configuration can be punched out to advantage. Thus, it is only necessary that a portion of the forwardly extending punch, when projected onto the workpiece, is located within the projection onto the workpiece of the punch intended for free-punching the elements.

The invention is thus not restricted to the described and illustrated embodiments, but can be modified within the scope of the following claims.

What we claim is:

1. An apparatus for punching elements from a flat workpiece comprising

a punch holder capable of moving towards and away from the workpiece and rigidly connected to at least two punches,

actuating means for delivering impact forces to the punch holder with sufficient energy to carry out each punching operation,

punch dies arranged to co-act with the punches,

means for arresting movement of the punch holder immediately after an element has been punched free from the workpiece

wherein at least one first punch for making a first perforation in the workpiece is located, when projected onto the workpiece, at least partially within the surface of projection of a second punch for free-punching the elements from the workpiece and projects beyond the free-punching punch through a distance which is substantially equal to the least distance which the first punch must be inserted into the workpiece in order to effect said perforation and further

wherein the punch die of the first punch in its co-acting position with the first punch prevents by abutment via the workpiece facing the workpiece, free-punching of the elements to be punched out, and

means for temporarily arresting the movement of the punch holder immediately after the first perforation is made in the workpiece

wherein at least the die associated with the first punch can be moved away from its co-acting position with the first punch while the first punch projects into a perforation which it has made in the workpiece.

2. An apparatus according to claim **1,** characterized in that the punch die intended to co-act with the first punch is capable of being removed in the direction of the working stroke of the punch holder.

3. An apparatus according to claim **1,** characterized in that the punch dies are mounted on a punch die holder capable of moving transversely of the working stroke of the punch holder.

4. An apparatus according to claim **1,** characterized in that said actuating means are capable of being reset to alternately impart to the punch holder energy adapted for punching said perforation and for free-punching an element.

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