Jan. 24, 1967 R. GOLDMAN 3,299,761

PUNCH ASSEMBLY

Filed Nov. 6, 1964 3 Sheets-Sheet 1

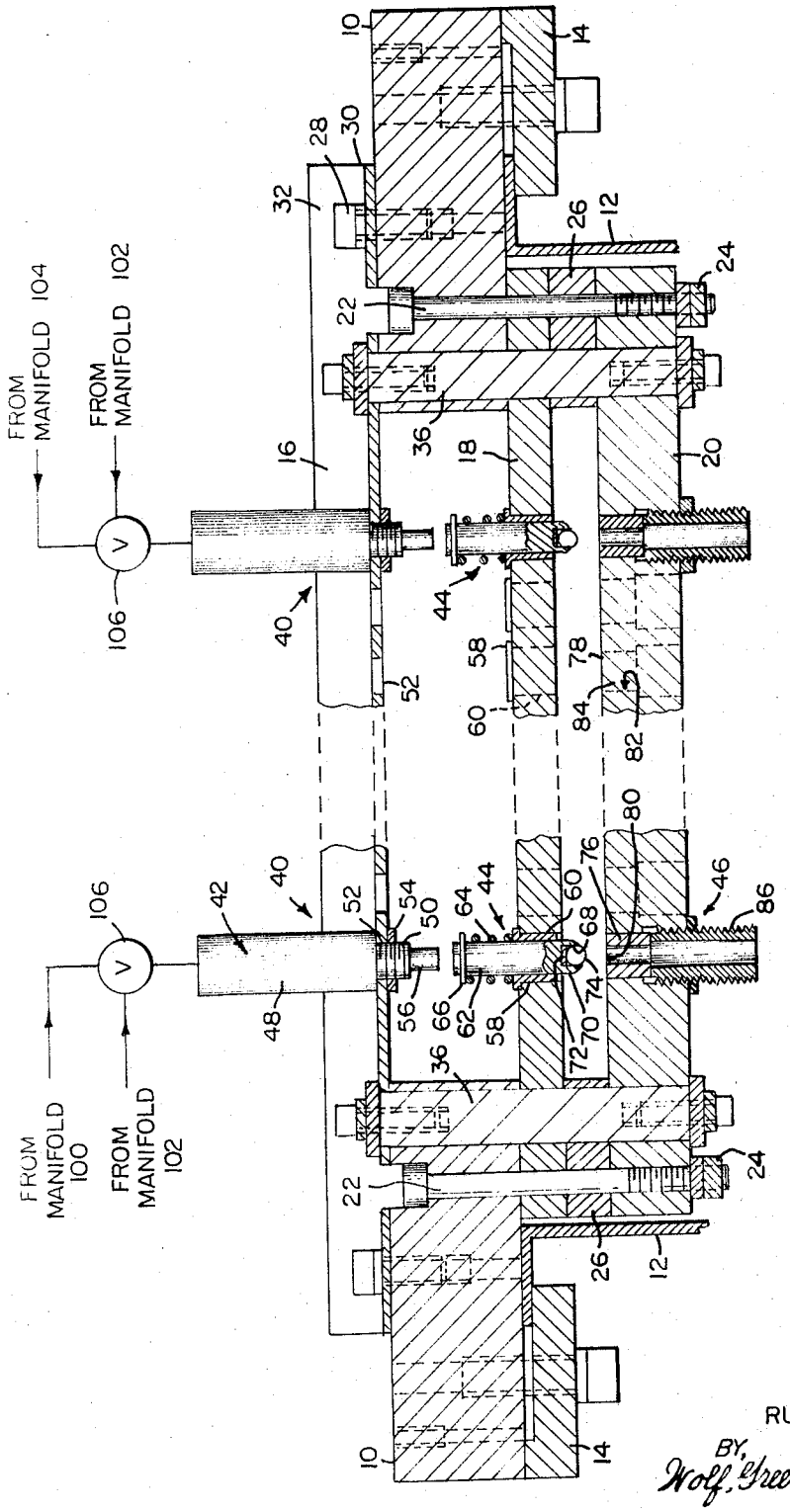


FIG. 1

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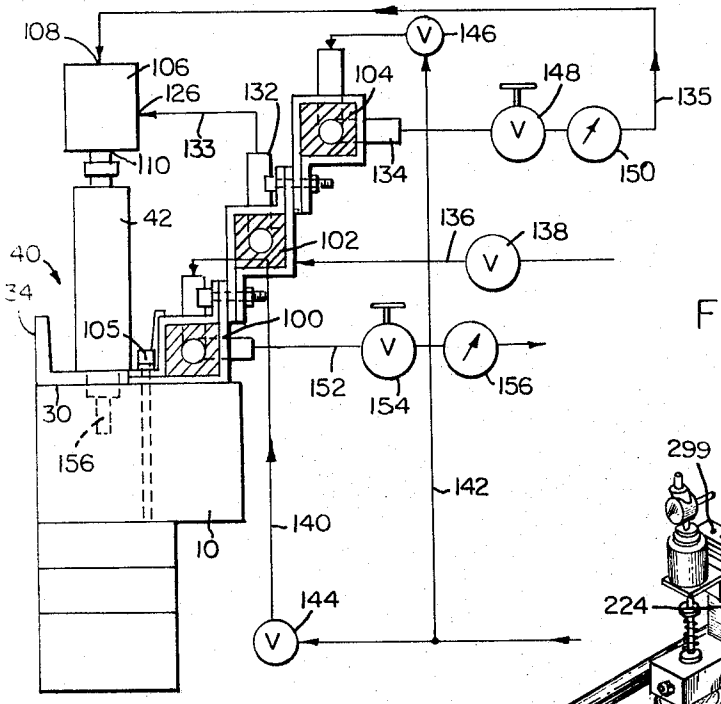


FIG. 2

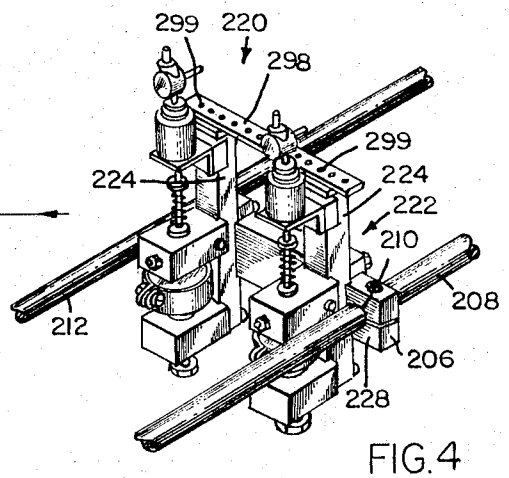


FIG. 4

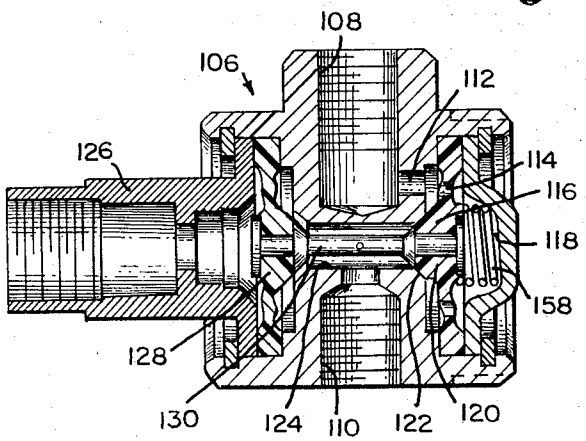


FIG. 3

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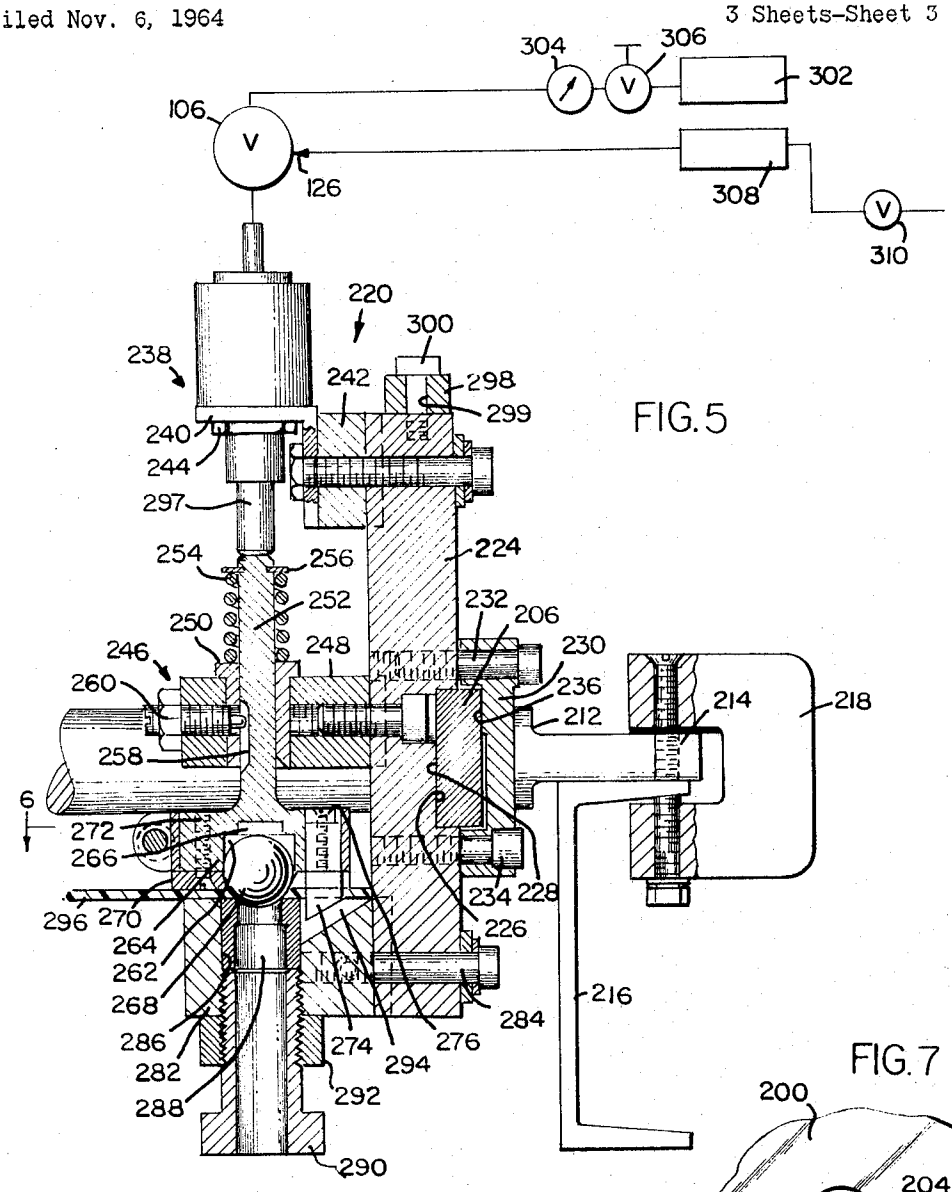


FIG. 5

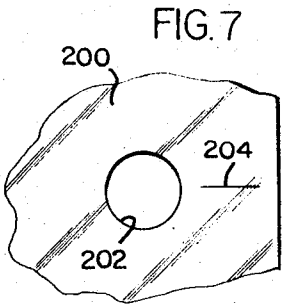


FIG. 7

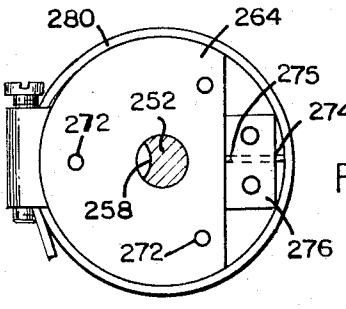


FIG. 6

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PUNCH ASSEMBLY

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Filed Nov. 6, 1964, Ser. No. 409,415
15 Claims. (Cl. 83—639)

This invention relates to punching apparatus and more particularly comprises a new and improved multi-punch assembly for perforating thin sheet stock. The device may include as a part thereof a knife for simultaneously slitting the stock as it is perforated.

In recent years polyethylene bags have come into widespread use to package such diverse products as food stuffs, clothing and scientific instruments. In certain of such uses, it is necessary to provide perforations in the bags to allow air to circulate about the goods packaged in them. To form the perforations most economically in the plastic sheet material of the bags, it is customary to mount on the bag making machines auxiliary equipment which will perform the punching operations while the bag making machines cut, fold and seal the edges of the sheet to form the bags.

One important object of this invention is to provide a multi-punch assembly for use on bag making machines which may be readily adjusted to vary the positions of the holes formed in the sheet material passing through the punch assembly.

Another important object of this invention is to provide a punch assembly which is capable of simultaneously punching very closely spaced holes in a sheet moving through the assembly.

Another important object of this invention is to provide a multi-punch assembly which is relatively inexpensive to manufacture and which is capable of giving long trouble free service.

Yet another important object of this invention is to provide a multi-punch assembly which can simultaneously punch and slit the sheet material which passes through it.

Still another important object of this invention is to provide a control system for a multi-punch assembly, which has a minimum number of moving parts, is free of all costly electrical control elements and which may be serviced and adjusted by a technician with limited training.

To accomplish these and other objects, the multi-punch assembly of this invention includes a frame which supports a plurality of independent punch mechanisms each capable of perforating sheet material passed through the assembly. A pneumatic control system is connected to each of the punches for simultaneously actuating all of the punches to form a plurality of perforations in the sheet. In one of the embodiments of this invention the punch carries a slitting knife which is simultaneously actuated with the punch to form a cut in the material adjacent the perforation.

These and other objects and features of this invention along with its incident advantages will be better understood and appreciated from the following detailed description of two embodiments thereof, selected for purposes of illustration and shown in the accompanying drawing, in which:

FIG. 1 is a front elevation view, partly in section, showing one embodiment of a multi-punch assembly constructed in accordance with this invention;

FIG. 2 is an end view of the assembly of FIG. 1 with the pneumatic control system shown diagrammatically;

FIG. 3 is a cross-sectional view of a control valve forming part of the pneumatic control system;

FIG. 4 is a perspective view of another embodiment of this invention;

FIG. 5 is a cross-sectional view of one of the punch units in the assembly shown in FIG. 4;

FIG. 6 is a cross-sectional view taken along the corresponding section line in FIG. 5; and

FIG. 7 is a plan view of a sheet punched and cut by the apparatus of FIGS. 4–6.

In FIG. 1 but two of a plurality of punch units are shown mounted in the assembly. The assembly shown includes a pair of blocks **10** which comprise part of its frame, and the blocks **10** in turn are shown secured to a pair of angle irons **12** on opposite sides of the assembly by mounting clamps **14** screwed to the lower surface of the blocks. The angle irons **12** represent a portion of the frame of a bag making machine or some similar machine on which the multi-punch assembly is used as auxiliary equipment. Therefore, the angle irons **12** and the frame that they represent form no part of the present invention.

Three independent frame members **16**, **18** and **20** extend between the blocks **10**. The member **16** serves as a cylinder holder, the member **18** as a punch holder, and the member **20** as a die holder. The members **18** and **20** are secured to the blocks **10** by screws **22** and bolts **24** which pass through the blocks **10**, the ends of the member **18**, spacers **26** and the lower member **20**. The top member **16** is secured to the upper surface of the blocks **10** by screws **28** that pass through the web **30** of the member **16** and are anchored in the blocks. It will be noted in FIGS. 1 and 2 that the member **16** is an angle having a front flange **34** and web **30**. The members **16**, **18** and **20** are precisely aligned with one another on the block **10** by means of the dowel assemblies **36**.

In FIG. 1 it will be noted that each of the two punch units **40** is generally composed of three parts; namely, a cylinder unit **42**, punch unit **44** and die unit **46**. The cylinder unit **42** includes a body **48** having a downwardly extending externally threaded collar **50** which is mounted in a hole **52** in the web **30** of the member **16** by nut **54** threaded onto the collar **50**. Plunger **56** extends out of the collar **50** below the web **30** and serves as a direct actuator for the punch unit **44**. The cylinder unit **42** is pneumatically actuated by a control system which will be described in detail below.

The punch unit **44** is slidably mounted in a bushing **58** which lines the opening **60** in the punch holder **18**. Each opening **60** in the holder **18** is shown lined with its own bushing. The punch body **62** is biased to an elevated position as shown in FIG. 1 by spring **64** which bears against the upper surface of the bushing **58** and a ring **66** secured to the top of the punch body.

A cavity **68** is provided in the lower end of the punch body **62**, which cavity is defined by a circular skirt **70**. A hardened steel backer **72** is mounted in the top of the cavity **68**, and the ball **74** of the punch is spun into the cavity or the lower end of the skirt is struck over to retain the ball in place.

The die unit **46** includes a die button **76** having its upper surface substantially in the plane of the upper surface **78** of the die holder **20**. The die button **76** is in the form of a sleeve having a sharp upper inner edge **80**

which cooperates with the ball **74** to perform the cutting operation. In FIG. 1 it will be noted that the openings **82** in the die holder **20** which receive the buttons **76** have an upper portion **84** of smaller diameter in which the die buttons **76** are mounted. The lower portion of each opening **82** is of larger diameter and is threaded, and an adjusting screw **86** supports the die button **76** at the correct elevation in the upper portion **84** of the opening. The adjusting screw enables the operator to periodically raise the die button **76** as wear takes place with continued use of the mechanism, and to compensate for regrinding of the upper surface of the button to sharpen the cutting edge **80**.

In the assembly of FIG. 1, the frame members or holders **16**, **18** and **20** are shown broken to shorten the illustration, and but five sets of openings each including one each of openings **52**, **60** and **82** are shown provided in the three members, respectively. In the actual assembly some sixteen sets of holes are provided in the members so that sixteen punch units can be simultaneously mounted on the assembly to form holes in material fed through the assembly. The material being punched is normally fed through the assembly on the upper surface **78** of the die holder **20**, and the material being punched is advanced between actuations of the punches.

In FIG. 2 the control mechanism for actuating the punches is illustrated. In that figure three manifolds **100**, **102** and **104** are shown disposed behind the cylinder unit **42** in stepped arrangement. The manifolds **100**, **102** and **104** are made from square aluminum extrusions with a hole extruded in the center. The extrusions are held together by clamps made from bent plates bolted together along their edges. The manifold assembly is secured to the blocks **10** by blots **105**.

The cylinder unit **42** as shown in FIG. 2 carries an impulse valve **106** which is shown in detail in FIG. 3. The impulse valve controls the flow of air to the cylinder **42** so as to control the actuation of its plunger **56**. When the valve **106** is opened air is directed into the cylinder **42** above its piston (not shown), and its plunger **56** strikes the punch body **62**. The valve **106** is of standard design and is extremely beneficial in the system.

The valve **106** is shown to have an inlet fitting **108** adapted to be connected to a compressed air source and an outlet fitting **110** which in FIG. 2 is shown secured to the top of the cylinder **42**. Flow from inlet fitting **108** is through passage **112** in the body and an opening **114** in the rubber diaphragm **116** to chamber **118**. When the rubber diaphragm moves to the right as shown in FIG. 3 it forms a gap between its conical portion **120** and the valve seat **122**, and air may flow directly from the passage **112** into the axial passage **124** in the body which in turn communicates with the outlet fitting **110**.

A control fitting **126** secured to the body of valve **106** is also adapted to be secured to a compressed air source. When so connected, air under pressure is directed against the left face of another diaphragm **128** mounted on the left end of passage **124**. The diaphragm **128** is mounted in tandem with the diaphragm **116** by means of the pin connection **130**, and when the pressure exerted against the left face of the diaphragm **128** exceeds the pressure exerted against the right face of the diaphragm **116** from chamber **118**, the conical portion **120** of the diaphragm **116** removes from the seat **122**, and the inlet and outlet fittings **108** and **110** are placed in communication with one another. Thus it is seen that in FIG. 2 compressed air may be directed through the impulse valve **106** from the inlet fitting **108** to the outlet fitting **110** so as to activate the cylinder **42** to lower the plunger **56** when the fitting **126** is connected to a compressed air source.

In FIG. 2 the fitting **126** is shown schematically to be connected to an outlet fitting **132** on the second manifold **102** by duct **133**. An outlet fitting **134** on the manifold **104** is shown connected to the inlet fitting **108** of the impulse valve **106** by duct **135**. The center manifold **102** is in turn connected to a compressed air source by means of a duct **136** shown achematically which may be controlled by a solenoid valve **138**. The manifolds **100** and **104** are connected to a compressed air source through lines **140** and **142**, which respectively contain shut off valves **144** and **146**. It will also be noted in FIG. 2 that a pressure regulator valve **148** and a gage **150** are provided in the line **135** connecting the manifold **104** to the fitting **108** of the impulse valve **106**.

As suggested above, one of the advantages of this invention is the ability to place a plurality of punches in very close proximity to one another on the assembly. It will be noted in FIG. 1 that the openings in the members **16**, **18** and **20** are closely spaced so that when punch units are mounted in each of the sets of openings the cylinders of the different units almost touch one another. In order to control each of the punches effectively, and not crowd or complicate the hose connections between the manifolds and the impulse valves, the manifolds **100** and **104** are alternately connected to the punch units. Thus, every other punch unit may be connected to the manifold **104** in the manner shown in FIG. 2, and the intervening punch units may be connected to the manifold **100** by means of the line **152**. It will be noted in FIG. 2 that the line **152** contains a pressure regulator **154** and a gage **156** identical to the gages in the line **135** from the manifold **104**. However, the manifold **102** controls the actuation of each of the impulse valves of the punch units. Thus, in FIG. 1 the impulse valves **106** are shown each to be controlled by manifold **102**. However, one of the valves **106** is connected to a compressed air source which operates the cylinder through manifold **104** while the other is connected through manifold **100**. Ordinarily the valves **144** and **146** in the lines to the manifolds **100** and **104** are open and consequently air under pressure is available to operate the cylinders at the impulse valves **106**. The fittings **126** of the impulse valves are all connected to the manifold **102**, and they are in turn simultaneously controlled by the solenoid valve **138**. When the solenoid valve **138** opens directing air under pressure to the manifold **102**, the impulse valves **106** are in turn opened by the pressure exerted on their diaphragms **128**. Consequently all of the punch units **44** are simultaneously actuated as their respective impulse valves are opened. When the solenoid **138** is closed springs **158** in the impulse valves reseat the conical valves **120** on the seats **122** and no more compressed air is delivered through the impulse valves to the tops of the cylinders. The cylinder plungers **56** are in turn returned to the raised position by springs (not shown) within the cylinder bodies.

Because the several manifolds **100**, **102** and **104** extend substantially the full length of the frame members or holders **16**, **18** and **20**, the outlet fittings from the manifolds **100** and **104** are conveniently spaced along the manifolds behind the blocks **10**, and it is easy to connect and disconnect the several ducts from those manifolds leading to the inlet fittings of the impulse valves. Further the center manifold **102** is provided with a series of outlet fittings **132** which are relatively closely spaced and which are connected by ducts to the fittings **126** of each of the impulse valves. The individual ducts or lines connected between the manifold and the impulse valves are relatively short and do not have a tendency to become tangled or twisted, which would make repair difficult.

It will be appreciated that the manifold **102** is provided with an outlet fitting for each of the stations defined by the sets of openings in the members **16**, **18** and **20**. However, the pliable plastic hoses are made long enough so that it is unnecessary to disconnect the hoses from the manifold each time an assembly is moved from one station to another. It is apparent that the punch units themselves may be conveniently transferred from station to station in the assembly. By unscrewing the lock nuts **54** the cylinder units may be transferred from opening to opening in the member **16**. The punch units **44** may be

transferred from one bushing 58 to another in the openings 60 provided in the member 18, and the dies may be transferred from opening to opening merely by removing the adjusting screws 86 and droping the die buttons into another of the openings.

The embodiment of FIG. 4 differs from that of FIG. 1 in several respects. First, while the punch units of the assembly of the embodiment of FIG. 1 merely punch holes in the stock fed through the assembly, the punch units of the embodiment of FIG. 4 both punch and slit the sheet material as suggested in FIG. 7. In FIG. 7 a fragment 200 of a plastic sheet is shown provided with a hole 202 and a slit 204 which are simultaneously formed in the sheet by the unit of FIG. 4. Further, the assembly of FIG. 4 is composed of two punch units which may be moved toward and away from each other on a mounting bar 206 in an infinite variety of positions.

In FIG. 4 the mounting bar 206 is shown to be slidably mounted on a rod 208 which passes through a hole 210 at the right end of the bar. A similar hole not visible in FIG. 4 receives another rod 212 on the left side of the unit. In FIG. 5 one end 214 of rod 212 is shown secured to a channel member 216 by a C-clamp 218. The channel 216 represents a portion of the frame of a bag making machine or other machine on which the assembly of FIG. 4 is used as auxiliary equipment.

The two punch units 220 and 222 mounted on the mounting bar 206 are identical and one is shown in detail in FIG. 5. The unit 220 is shown in FIG. 5 to include a post 224 which is vertically oriented and slidable horizontally along the mounting bar 206. A recess 226 in the post 224 receives the front face 228 of the mounting bar 206, and a mounting clamp 230 is secured at the top and bottom by screws 232 and 234 to the rear surface of the post 224 about the bar 206. By loosening the top screw 232, the gripping surface 236 of the clamp may be moved away from the rear surface of the bar 206 so that the unit 220 may slide horizontally on the bar. To secure the unit fast in a fixed position on the bar it is only necessary for the operator to tighten the screw 232.

A cylinder 238 is carried on an angle bracket 240 secured to the block 242 bolted to the upper portion of the post 224. The cylinder 238 may be removed from the horizontal arm of the bracket 240 by unscrewing the nut 244.

A punch unit 246 is carried by a punch holder 248 mounted on the post 224 below the block 242. Like the previously described embodiment, the holder 248 is provided with a bushing 250 seated in a hole in the holder 248, which slidably receives punch body 252. The punch body 252 is urged to an elevated position by a spring 254 which surrounds the upper portion of the body and bears against the top of the bushing 250 and a ring 256 secured to the punch body adjacent its top. A keyway 258 in the side of the punch body 252 receives a key 260 carrying a locking nut, which passes through an opening in the bushing 250 and a threaded hole in the holder 248, to prevent the punch body 252 from turning in the bushing. Alternatively, alignment of the punch body may be maintained by such means as posts extending upwardly on the lower end of the body, which register with holes in the holder 248.

The lower end of the body 252 is enlarged and includes an axial cavity 262 in its bottom defined by a surrounding skirt 264. A hardened backup plate 266 is provided in the cavity and the punch ball 268 is retained in the cavity by a hardened ring 270 screwed to the skirt 264 by screws 272.

The enlarged lower portion of the punch body 252 also carries a cutting blade 274 in vertical slot 275, which is supported by a backup plate 276. The blade 274 may be of a variety of shapes and may be designed to make either a single cut or a series of short serrations, and the cuts may extend either to the edge of the sheet being cut or alternatively the cuts may be positioned inwardly of the edge as shown in FIG. 7. The blade 274 is retained in place by a hose-type clamp 280 which surrounds the lower portion of the body as is clearly shown in FIG. 6. It will be noted in FIG. 5 that the retaining ring 270 has a somewhat greater diameter than the lower portion of the body to prevent the clamp from sliding downwardly off the enlarged lower end.

Below the punch unit 246 a die holder 282 is bolted by means of screw 284 to the post 224. The die holder 282 is provided with an opening 286 aligned axially with the punch. The die button 288 is positioned in the opening 286 by an adjustable screw 290 and lock nut 292. In FIG. 5 it will be noted that the screw 290 is threaded into the lower end of the opening 286 and supports the bottom of the die button 288.

An inclined slot 294 is formed in the die holder 282 and extends radially from the opening 286. The slot 294 is aligned with the blade 274 so as to receive the blade when the punch body 252 is driven downwardly by the cylinder 238. In FIG. 5 the ball 268 and the knife 274 are shown in their operative positions wherein they are punching and cutting a sheet of plastic material represented at 296. The cylinder 238 is shown in its active position with its plunger 297 in its lowermost position bearing against the punch body 252. It will be noted that the spring 254 is compressed in the position shown. When the plunger 297 returns to its elevated position in the cylinder 238, the spring 254 returns the body 252 to an elevated position so that the ball 268 unseats from the cutting edge of the die button and the blade 274 rises out of the slot 294.

In FIG. 4 the two posts 224 of the units 220 and 222 are tied together by a graduated spacer bar 298 provided with a series of holes 299 through which screws may pass and attach to the upper surfaces of the posts 224. In FIG. 5 the spacer bar 298 is shown secured to the top of the post 224 by screw 300. If the holes 299 in the spacer bar 298 are graduated accurately, they may be used to accurately position the two punch units with respect to the plastic material fed through the machine.

As in the previous embodiment, an impulse valve 106 is mounted on top of each cylinder 238, and as shown schematically in FIG. 5, the top of the valve 106 is connected to one manifold 302 through a gage 304 and pressure regulator 306. A second manifold 308 is connected to the control inlet 126 of the impulse valve, and a solenoid 310 controls the flow of compressed air to the manifold 308. Therefore, when the solenoid 310 is open, the manifold 308 is charged, which activates the impulse valve 126. In response to this the manifold 302 directs compressed air through the valve 106 to the cylinder 238 to activate the plunger 297. When the valve 310 closes, the pressure is relieved against the diaphragm in the impulse valve 106, and consequently the valve closes to disconnect the manifold 302 from the cylinder 238. Consequently, the spring (not shown) in the cylinder 238 returns the plunger to its elevated position. It will be understood and appreciated that the manifold 308 may control the impulse valves on both of the punch units so that both punch units are activated simultaneously, and the manifold 302 may be connected to each of the impulse valves so as to provide a driving charge for the cylinders.

From the foregoing description it will be appreciated that in each of the multi-punch assemblies shown the position of the punches may be adjusted to suit the particular needs of the fabricator. Further, a simple adjustment is provided in each of the punches to raise the die whenever necessary to insure clean punching of the stock. The simple pneumatic controls for the punches are virtually free of all complex parts so that the controls will have a long trouble free life.

From the foregoing description those skilled in the art will appreciate that numerous modifications may be made of this invention without departing from its spirit. There-

fore it is not intended to limit the breadth of this invention to the specific embodiments illustrated and described. Rather, it is intended that the scope of this invention be determined by the appended claims and their equivalents.

What is claimed is:

1. A punch assembly comprising
a frame having a pneumatic cylinder holder, a punch holder and a die holder,
a die mounted on the die holder and a punch mounted in its holder,
a pneumatic cylinder mounted on the pneumatic cylinder holder and when energized driving the punch toward the die holder, said die, punch and cylinder forming a punch unit,
a spring return mounted on the punch for returning the punch to a position away from the die holder when the cylinder is deenergized,
a passage for connecting the cylinder to a compressed air source,
an impulse valve in the passage and having an inlet and a control inlet,
means for maintaining the inlet of the impulse valve in communication with the source,
means including a second passage connecting the control inlet to a compressed air source, said control inlet when connected to the source opening the impulse valve to connect the inlet of the valve to the cylinder for energizing the cylinder,
and a control valve in the second passage for opening and closing the passage.

2. A punch assembly as defined in claim 1 further characterized by
said punch including a body and a ball carried by the body,
and said die including a sleeve aligned with the ball and having a cutting edge cooperating with the ball for cutting round holes in stock fed through the punch.

3. A punch assembly as defined in claim 2 further characterized by
a blade carried by the body,
and a slot in the die holder alinged with the blade for receiving the blade enabling the blade to pierce the stock when the ball and die cut round holes therein.

4. A punch assembly as defined in claim 1 further characterized by
a second punch unit mounted on the frame and including another impulse valve connected to the cylinder of the second unit,
and means connecting the impulse valve of the second unit in parallel with the impulse valve of the first first unit so that the cylinders are simultaneously actuated to actuate their respective punches together.

5. A punch assembly as defined in claim 3 further characterized by
a second punch unit mounted on the frame and including another impulse valve connected to the cylinder of the second unit,
and means connecting the impulse valve of the second unit in parallel with the impulse valve of the first first unit so that the cylinders are simultaneously actuated to actuate their respective punches together.

6. A multi-punch assembly comprising
a frame having a plurality of sets of aligned holes provided therein for supporting punches, dies and pneumatic cylinders,
punches, dies and pneumatic cylinders mounted on the frame in the holes and suitable to be moved from one set of holes to another,
an impulse valve connected to each cylinder and having a control port which opens the valve when placed under pressure, each of said valves controlling the flow of air under pressure to its respective cylinder,
first means connected to the impulse valves for simultaneously impressing a pressure on the control ports of the impulse valves,

and second means connected to the impulse valves for directing compressed air through the impulse valves to the cylinders when the impulse valves are opened.

7. A multi-punch assembly comprising
a frame,
a plurality of punch units including pneumatic cylinders mounted on the frame,
an impulse valve connected to each cylinder and having a control port which opens the valve when placed under pressure, each of said valves controlling the flow of air under pressure to its respective cylinder,
first means connected to the impulse valves for simultaneously impressing a pressure on the control ports of the impulse valves,
and second means connected to the impulse valves for directing compressed air through the impulse valves to the cylinders when the impulse valves are opened.

8. A multi-punch assembly as defined in claim 6 further characterized by
said first means including a manifold with separate ducts connected between the manifold and each of the control ports,
and a line and control valve for connecting the manifold to a source of air under pressure for charging the manifold.

9. A multi-punch assembly as defined in claim 8 further characterized by
said second means including a second manifold with separate ducts connected between the second manifold and some of the impulse valves for maintaining a charge of compressed air at the inlet side of the impulse valves.

10. In a multi-punch assembly;
a frame,
a plurality of actuating cylinders mounted on the frame,
at least two manifolds disposed adjacent to the frame and connected to a compressed air source,
means including pneumatically controlled valves connecting one of the manifolds to each of the actuating cylinders for supplying compressed air to the cylinders to operate said cylinders,
and ducts connecting the other manifold to the pneumatically controlled valves to supply controlling air to the pneumatically controlled valves to open said valves.

11. A punch assembly comprising
a frame having a punch holder and die holder,
a punch body slidably mounted in the punch holder and movable toward and away from the die holder,
a ball secured to the end of the punch body toward the die holder,
a sleeve-shaped die button mounted in the die holder and having a circular cutting edge in line with and engaged by the ball when the punch body is moved toward the die holder to cut a circular hole in sheet stock disposed between the die button and ball,
means for adjusting the position of the button in its hold to position it closer or further away from the punch body,
spring means secured to the body for yieldably urging the body away from the die holder,
and means operatively associated with the punch body for moving the body toward the die button and overcome the bias of the spring means.

12. A punch assembly as defined in claim 11 further characterized by
a slot in the die holder adjacent the button,
and a blade carried by the body and aligned with the slot and entering the slot when the ball engages the button.

13. A punch assembly as defined in claim 12 further characterized by
a second punch and die button mounted on the frame and substantially identical to the first described punch and die button,

and means for moving the two punches and die buttons toward and away from each other.

14. A punch assembly as defined in claim 13 further characterized by

said frame including a mounting bar,

a pair of posts slidable on the mounting bar toward and away from each other,

and said punch and die holders being mounted on the posts.

15. A punch assembly as defined in claim 14 further characterized by

a pair of parallel rods slidably supporting the mounting bar and adapted to be connected to a bag making machine enabling the bar to be adjustably positioned on the machine.

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