United States Patent

[11] **3,580,120**

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[54] **MULTIPURPOSE PUNCH**
7 Claims, 3 Drawing Figs.

[52] **U.S. Cl.** **83/98,** 83/516, 83/588, 83/639, 83/687
[51] **Int. Cl.** **B26d 7/18**
[50] **Field of Search** 83/98, 99, 123, 588, 639, 516, 687, 686; 77/69

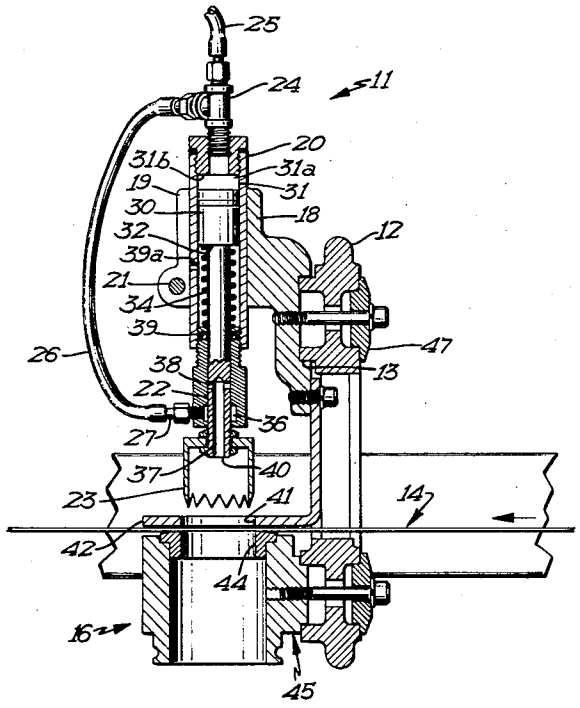
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ABSTRACT: Punching apparatus particularly adapted for use in connection with flexible film materials including a punching assembly and a die assembly arranged in aligned relation with the punching assembly, means for reciprocably shifting the punch into engagement with the die for performing a cutting operation on film disposed between the punch and the die, and including means for injecting a pulse of compressed gaseous fluid when the punch is in its extended disposition. Bores are formed within the punching apparatus to permit coupling of a source of gaseous fluid under pressure to the punching assembly for discharge from the surface of the punch member, the arrangement being such that gaseous fluid under pressure is discharged from the punch only when the punch member is in its extended position.



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SHEET 1 OF 2

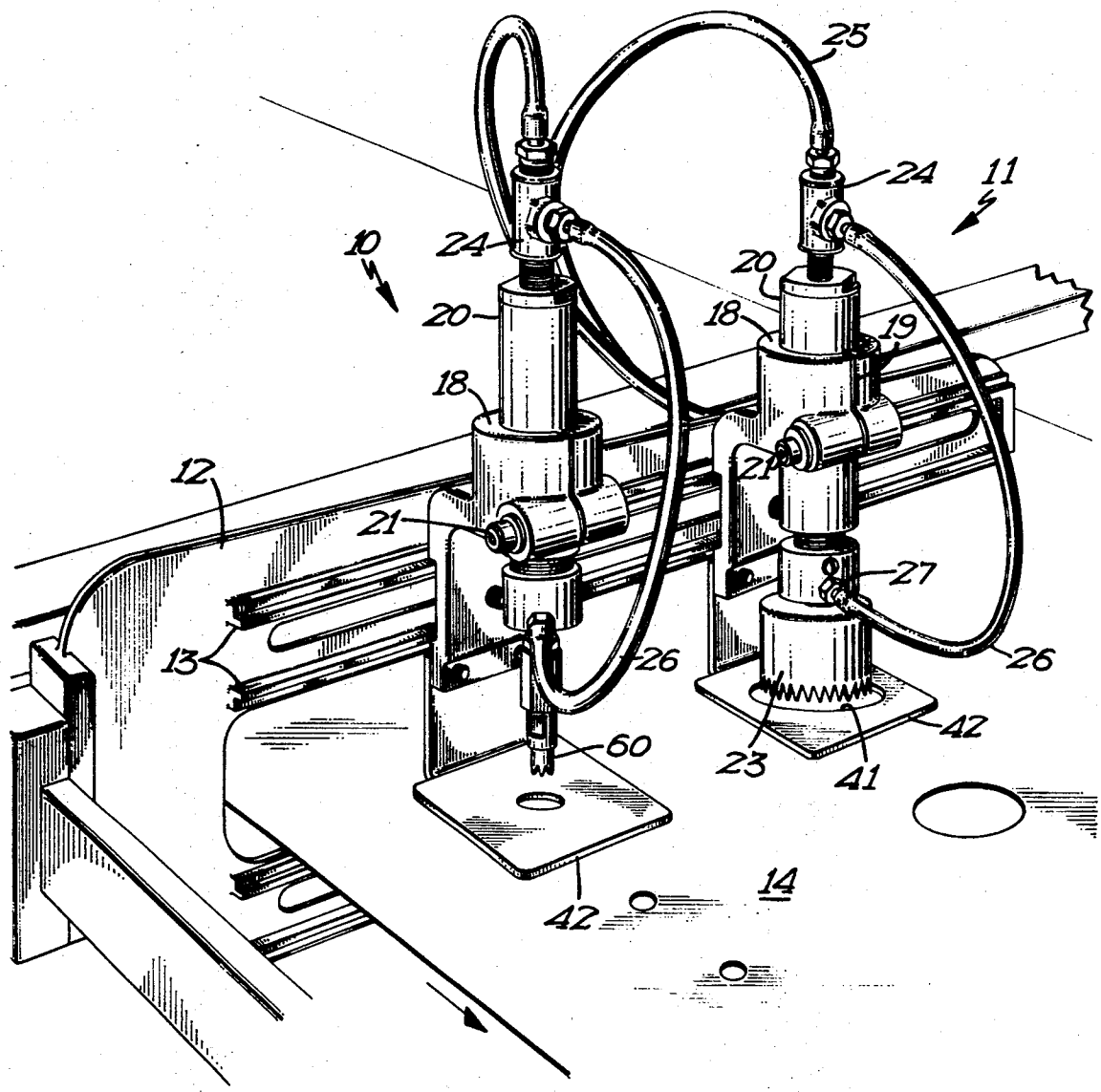


FIG 1

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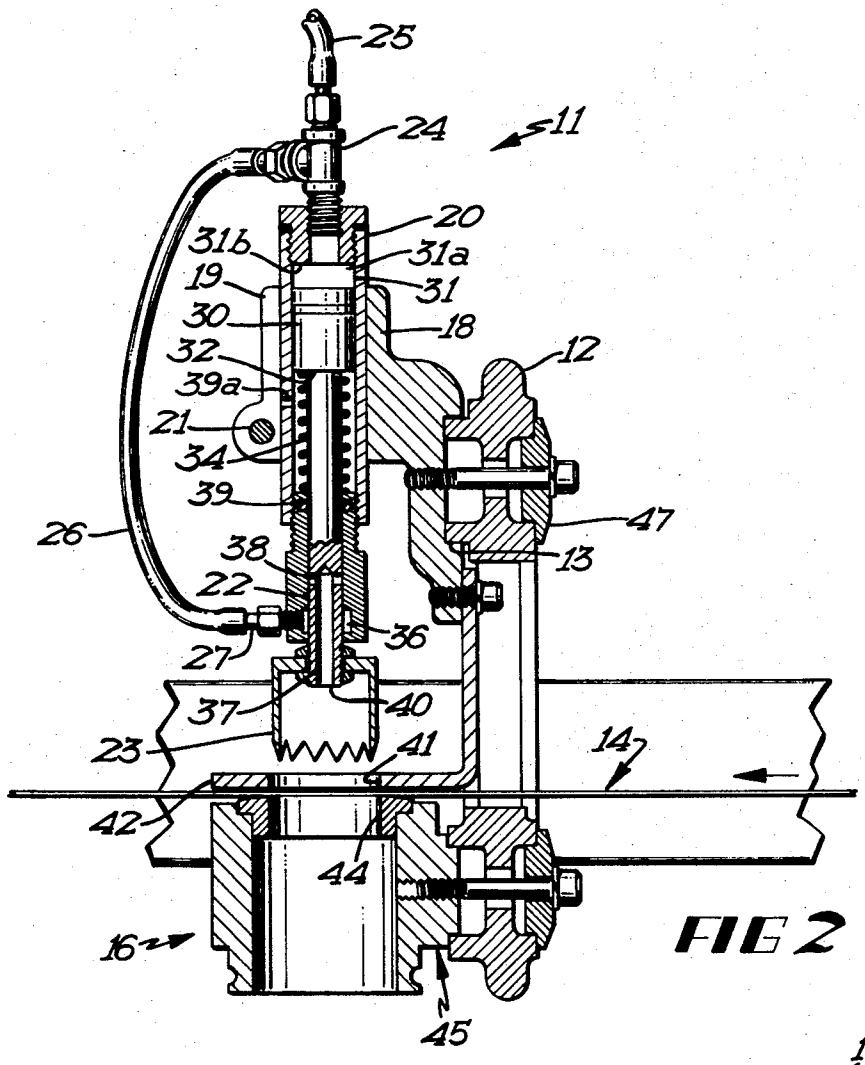


FIG 2

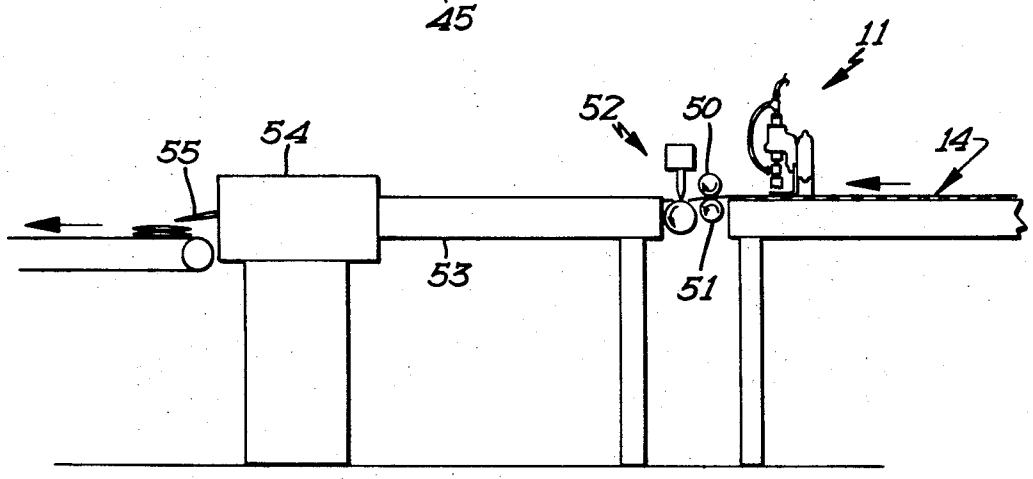


FIG 3

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MULTIPURPOSE PUNCH

The present invention relates generally to an improved reciprocating punching mechanism, and more particularly to a high-speed reciprocating punch device especially adapted for use in connection with thin flexible film materials. The punch apparatus includes a relatively movable punch and die, the punch having a surface which is adapted to engage the die surface so as to form openings or holes within film material passing in the zone or space which normally exists between the punch and the die. Means are provided for removing the slug of film material which is obtained or formed upon a punching operation or event.

In the forming of holes in thin materials, particularly by punching, it is extremely important that the slug be reliably removed from the punching device after each punching operation. Failure to remove this slug, as formed, may result in fouling of the apparatus with resultant poor performance of the punch. While various techniques have been proposed from time to time for the removal of this slug, as formed, the present concept provides for a reliable means of forcibly removing the formed slug immediately upon completion of the punching operation.

Briefly, in accordance with the present invention, a punch is provided which is adapted to reciprocate between a normal disposition and an extended disposition, the punch having a surface with engages a die surface while in the extended disposition. Film is adapted to travel in the plane separating the punch and the die, and preferably the film moves intermittently so as to have a period of dwell existing between periods of motion. While at dwell, a punch moves into contact with the die and the punching operation is accordingly accomplished. Means are provided within the core of the shank supporting the punch to transfer or couple a source of compressed air which is discharged through a bore formed in the die engaging face. This compressed air is pulsed intermittently, the pulse being delivered to the face of the punch only upon its substantially reaching the fully extended disposition, this position being reached immediately after the punching operation has been completed. This arrangement provided for the coupling of the punch directly to line pressure of compressed air, for example, thus making the punching operation precise, and providing a minimum of interference with the sheet of film material. Obviously, if compressed air is to be discharged from the punch, care must be exercised so as to avoid the discharging of air onto the surface of the film, which, if permitted to occur in haphazard or untimely fashion could result in a distortion of the film in the area being punched. The apparatus of the present invention provides for reliable removal of slugs formed in the punching operation, this removal being achieved without distorting or otherwise disturbing the film as it moves between the punch and the die.

It is therefore an object of the present invention to provide an improved punching mechanism particularly adapted for use with thin flexible films, the punching apparatus including a reciprocating punch member together with a cooperating die member, means being provided to periodically introduct or discharge a pulse of compressed air from the punch surface so as to forcibly remove the slug therefrom.

It is a further object of the present invention to provide means for introducing a supply of compressed air to a punch member, the compressed air being discharged periodically upon completion of the reciprocatory extension or motion of the punch, this occurring after the punch has passed through the film surface.

It is yet a further object of the present invention to provide a cooperating punch and die which includes means for discharging pulses of compressed gaseous fluid from the surface of the punch after the punch is moved through the film surface, the discharge of compressed fluid at that time being possible without distortion of the film being punched.

It is yet a further object of the present invention to provide a highly accurate punch and die system particularly adapted for use with thin flexible film materials, the punch and die being provided with means for continuously supplying and periodically discharging compressed air from the punch, the air being discharged only upon the occasion of the punch being in its fully extended disposition.

Other and further objects of the present invention will become apparent to those skilled in the art upon a study of the following specification, appended claims, and accompanying drawings, wherein:

FIG. **1** is a front perspective view of a pair of punch assemblies arranged on a transversely extending bracket, the punches being shown with the web of flexible film material being moved therebelow;

FIG. **2** is a vertical sectional view taken generally along the central axis of the punch illustrated in FIG. **1**, this FIG. including a showing of the cooperating die immediately beneath the surface of the film; and

FIG. **3** is a side elevational view of a portion of a web handling system which includes the punches illustrated in FIGS. **1** and **2**.

In accordance with the preferred modification of the present invention, and with particular attention being directed to FIG. **1** of the drawings, there is shown first and second punch assemblies generally designated **10** and **11**, these punch assemblies being mounted on a transversely extending frame or bracket **12**. Means are provided for adjusting the lateral positioning of punches such as the punches **10** and **11** along the bracket **12**, these means including for example, the provision of mounting rails such as are shown, for example, at **13**. The web of film material is shown generally at **14**, and, as indicated, passes beneath the individual punches **10** and **11**. With attention being directed temporarily to FIG. **2** of the drawings, a cooperating die assembly shown generally at **16** is provided and disposed immediately below the surface of the film **14**, the operation of the punch and die being made manifest hereinafter.

The punches **10** and **11** are substantially identical, one to another, and hence this description will relate the details of the punch **11**, it being understood that the details of construction of punch **10** are generally identical to those of **11**. Each punch includes a mounting head **18**, the head having a support sleeve configuration as at **19** so as to adjustably retain the punch sleeve **20** therewithin. In other words, the sleeve **20** is received within the confines of the split head **18**, and can be disposed at any preferred elevation relative to the surface of the film **14**. An adjustable clamping screw is provided at **21** to accomplish this purpose. The punch arrangement which is generally in the form of a plunger is provided with a rod or shank portion **22**, the punching head with its die engaging surface **23** being secured to the front end thereof, the shank **22** and die engaging face **23** being adapted to move reciprocably within a bore formed in sleeve **20** and shown in detail in FIG. **2**. An actuating valve, not shown, transmits fluid under pressure to the T coupling **24** along line **25**, line **26** extending from the T **24** to the shank **22**, and terminating at the orifice **27**. An actuating cylinder is provided within the sleeve **20**, the actuating means including the piston **30** operating within the cylinder housing **31**, and being secured to the top end of the shank **22**, as at **32**. A helically wound spring member **34** is utilized to force the punch apparatus **11** into a normal retracted disposition, such as is shown in FIG. **2** with the retracted position being spaced from the upper end **31***b*. Suitable guide means and bushings are provided along with an O-ring seal **39** and a relief port **39***a* where indicated and needed, for proper operation and functioning of the system illustrated. The O-ring **39** presents leakage of compressed fluid around the shank portion **22**, as is conventional in this type of system.

With continued attention to FIG **2**, it will be observed that the orifice **27** which is coupled to line **26**, terminates in an annular chamber as at **36**. This chamber, as indicated, surrounds shank **22**, and is adapted to be in intermittent communication with the axial bore **37** formed within the shank **22**, depending upon the axial disposition of the plunger arrangement forming the punch. Crossbore **38** is provided for arranging intermittent communication between the annular zone **36** and the axial

bore 37. Upon entry of compressed gaseous fluid into the chamber 31*a* in cylinder 31, the piston 30 is forced downwardly, thus moving the punch 23 and shank 22 into extended disposition, this permitting communication to occur between bore 38 and annular chamber 36. Upon occurrence of that event, gaseous fluid under pressure is discharged from the orifice or opening 40 formed within punch 23 at the end of the axial bore 37.

It will also be observed that upon reaching its axial extended disposition, the die engaging face 23 will pass coaxially through the opening 41 formed in guide plate or shoe 42, and into coaxial punching contact with the punching sleeve 44. The punching sleeve 44 is mounted, as indicated, within die 16, the clamping assembly shown generally at 45 being utilized to control the transverse disposition of the die along bracket 12. The sleeve 44 is preferably threadably mounted within the die housing, so as to render it possible to convert the system to a different diameter punch, when desired. As is apparent from the showing of FIG. 2, compressed air under pressure cannot be discharged through orifice 40 into the annular zone confined by die engaging surfaces 23 except during the time that the punch head has penetrated the surface of the film 14. This construction is important to the functioning of the device in order to prevent the discharge of compressed air or other gaseous fluid under the surface of the film being treated.

The versatility of the mounting arrangement is demonstrated in FIG 2. In this connection, the mounting system includes a lower mounting bracket 45 which is utilized to clamp the die 16 into its desired disposition, and bracket 47 is utilized to mount the punch mechanism onto the bracket 12. Any desired location can then be reached with the system, depending upon the requirements of the operation. Thus, in setting up the mechanism, the punch and associated die can be mounted, as required, in the system to achieve the desired punching pattern in the film being treated. Obviously, multiple punches may be provided in the machine direction, as well as in the transverse direction. These requirements will, of course, depend upon the overall system being considered.

In operation, the punch mechanism is adapted to operate during dwell of the film 14. Upon achieving dwell, the valve controlling the introduction of air to the system opens, thus causing a downstroke of the piston 30. This cuts the hole in the film, as required. While the punch is in its downwardly extended disposition, communication exists between the crossbore 38 and the annular chamber 36, thus permitting the compressed air from the same source driving the piston 30 to discharge at the end of the downward motion of the cycle. This blast removes any slug present due to the cutting operation. The chamber is then exhausted through appropriate valving, and spring 34 returns the piston to its fully retracted position.

A typical installation is illustrated in FIG. 3, wherein the punching system 11 is utilized to treat a moving web of film 14. The system is provided with draw rolls 50 and 51, along with a sealing bar as at 52. The operation is coordinated so that during dwell of the film 14, the punching operation as well as the sealing operation occurs. Following severing of a flexible film article from the web by the bar 52, conveyor 53 transports the finished article to a discharge area 54, the finished articles 55 being discharged, as indicated.

It will be obvious that the punch can be employed for a variety of materials, and the specific application illustrated here is merely one regarded as typical.

We claim:

1. Punching means including a plunger arranged for reciprocatory to-and-fro motion and having a punch at one end thereof and actuating means at the other end thereof:
   a. said plunger including a shank with a generally annularly disposed die engaging face secured to one end thereof, a sleeve retaining and guiding said shank in closely spaced sliding relationship therewithin, said shank and said die engaging face being adapted to travel axially reciprocably within said sleeve for a predetermined stroke from a retracted position to an extended position and into contact with the mating surface of said die;
   b. a continuous bore formed within said shank and said die engaging face and extending generally axially within said shank from a bore opening formed in the annular zone within said die engaging face to a crossbore formed within said shank;
   c. a bore formed within said sleeve having inlet orifice means for receiving a supply of compressed gaseous fluid from a certain source and outlet orifice means along the inner wall of said sleeve and communicating with said inlet orifice along a bore formed in said sleeve and extending through the wall of said shank;
   d. the disposition of the outlet orifice of said sleeve bore being such that said sleeve bore and said crossbore are generally axially coincidental and in communication only when said shank is immediately adjacent the outward end of the extended disposition of its stroke, and are axially displaced when said shank is retracted from the extended disposition; and
   e. said actuating means for reciprocating the shank within said sleeve being responsive to compressed gaseous fluid from said certain source.

2. The punching means as defined in claim 1 being particularly characterized in that means are provided for coupling said sleeve inlet orifice to said certain source of compressed gaseous fluid.

3. The punching means as defined in claim 1 being particularly characterized in that said die engaging face comprises an annular serrated cutting edge.

4. The punching means as defined in claim 3 being particularly characterized in that said annular cutter and said shank are coaxially arranged.

5. The punching means as defined in claim 1 being particularly characterized in that said sleeve has an annular chamber formed around the inner periphery thereof, said chamber comprising said outlet orifice being in communication with said sleeve bore, and being arranged to be in communication with said crossbore only when said shank is in the outwardly extended disposition of said stroke.

6. The punching means as defined in claim 5 being particularly characterized in that said sleeve chamber is an endless annular chamber having a finite axial length.

7. The punching means as defined in claim 1 being particularly characterized in that spring means are provided for reciprocably driving said plunger from its extended position to its normal retracted position.