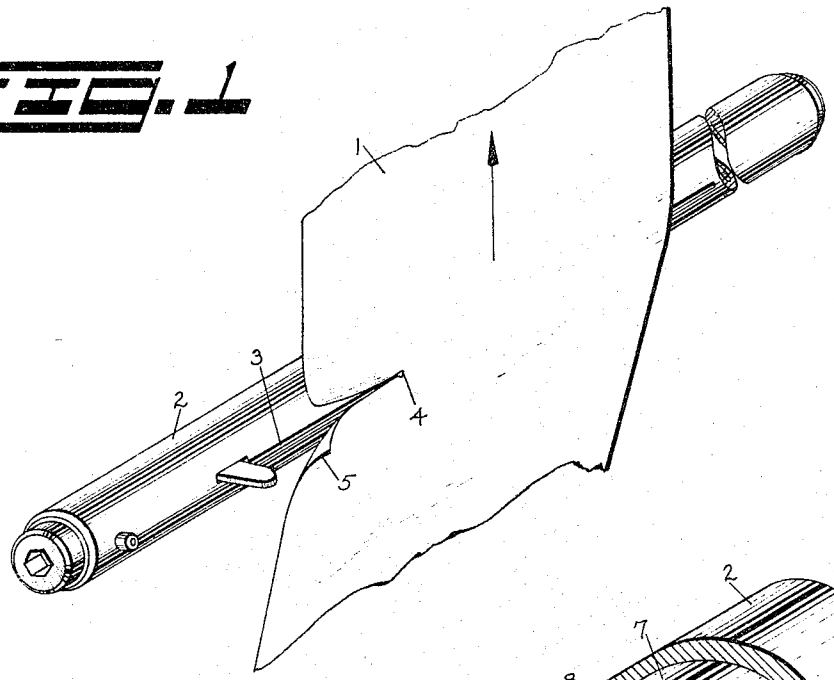
Oct. 11, 1966 D. F. DREHER 3,277,761

WEB SEVERING APPARATUS

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FIG. 1



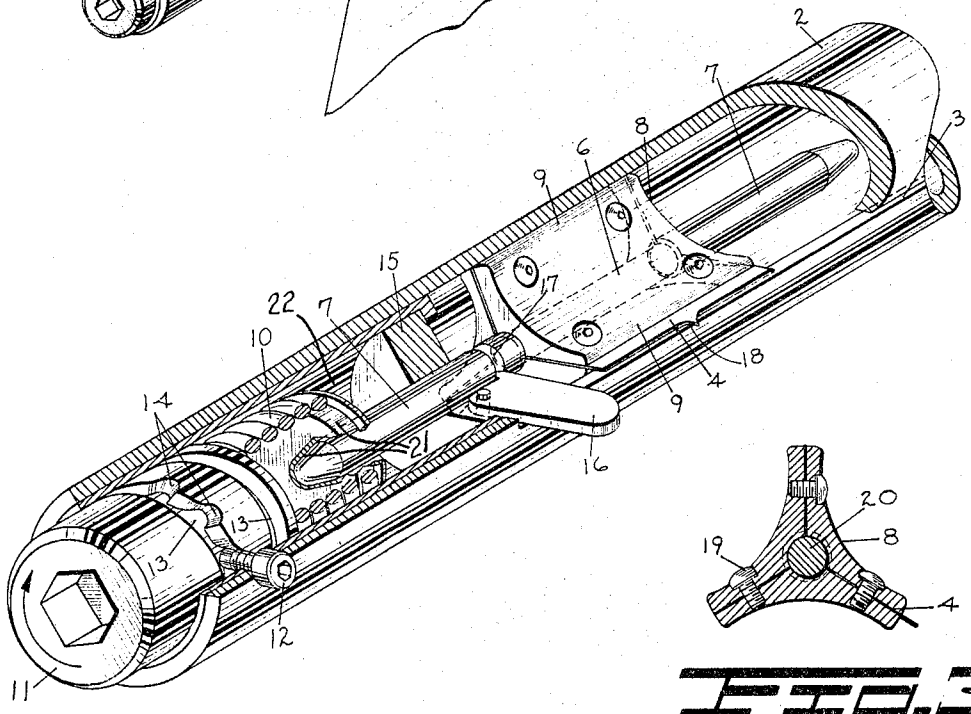


FIG. 2

FIG. 3

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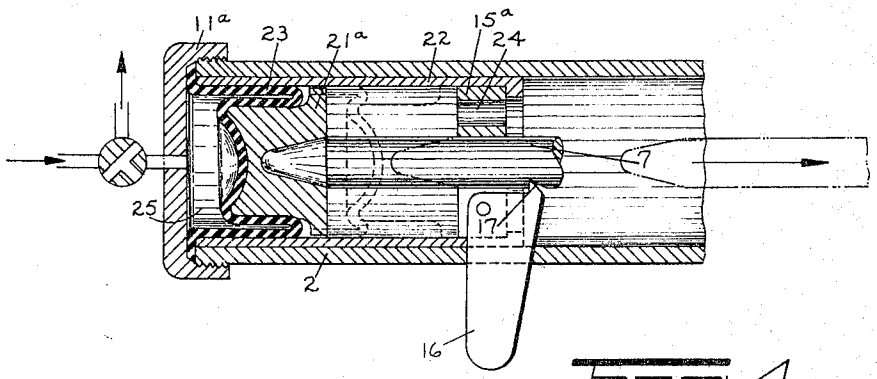


Fig. 4

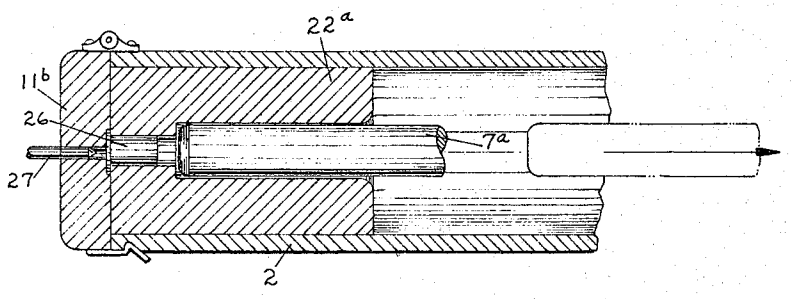


Fig. 5

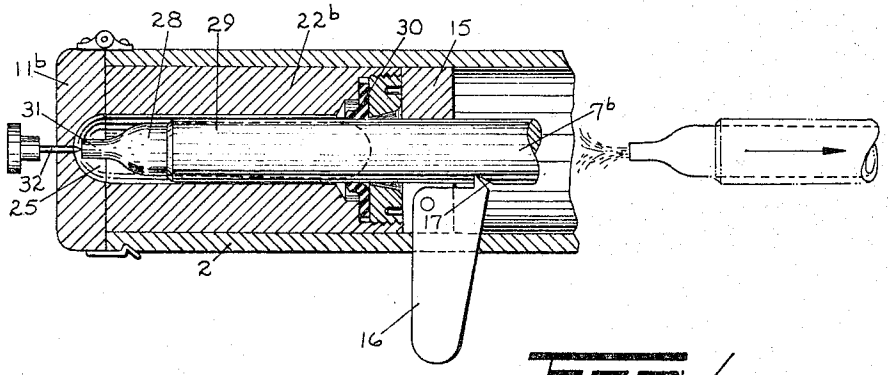


Fig. 6

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WEB SEVERING APPARATUS

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3 Claims. (Cl. 83—614)

This invention relates to means for severing a continuous web of paper, film or the like, which may be traveling at a relatively high speed. More particularly its primary application is as an essential component in high speed paster or web splicing apparatus in which the leading end of a new roll of paper or the like is attached to a running or expiring web in order to achieve web continuity and to permit uninterrupted operation. Its specific function in connection therewith is to sever the expiring web, ideally being timed so as to minimize the length of the web which trails behind the splice.

This function usually is accomplished by a jagged-edged guillotine which is designed to jab into the expiring web, thus causing rupture and web break. Such guillotines tend to be massive and complicated in structure, awkwardly space-consuming and often difficult to incorporate into deign without compromise. As a consequence of mass and the speed at which they must function, the amount of energy required for activation is sizable which further compounds the massiveness of the supporting structure. As running web speeds increase, the lag inherent in such mechanisms introduces additional timing problems with respect to lead time of triggering, especially if the free trailing segment is to be kept minimal in length at different running speeds. Additionally in some very high speed paster installations, abrupt insertion of the guillotine may upset web tension and result in failure of the paster to bond the two webs securely together.

In order more facilely to accomplish the severing of such a traveling web in a direct and simple manner I position a dart-like assembly at one end of a slotted tubular web-spanning enclosure, the dart-like assembly carrying a web-severing blade which protrudes through the lengthwise slot of the tubing. The slotted tube is positioned in web-deflecting contact with the expiring web. At the desired instant the blade-carrying dart is fired to the opposite end of the tubing where it is cushioned to a stop and retained, having slit the web cleanly from edge to edge in its bullet-like traverse. This web serving method may aptly be designated, "The Flying Blade."

Thus the basic object of the instant invention is to provide simple and foolproof means for cleanly severing a traveling web.

Another object is to reduce the space occupied by the web severing device.

Still another object is to simplify overall design, permitting optimal placement with minimal mechanical conflict and functional compromise.

A further object is to minimize the time-lag factor and to approach instantaneousness in web cut-off, permitting greater precision and closer timing.

A still further object is to eliminate tension upset occasioned by operation of the web severing device.

Still another object is to minimize the necessity for high tension in accomplishing web severance.

These and other objects of the subject invention may best be understood by referring to the accompanying drawings in which

FIGURE 1 is a perspective view showing a running web of paper in deflective contact with, and being severed by, the device described herein.

FIGURE 2 is a perspective view of one end of the slotted tube or barrel, partially cut away, exposing the dart assembly and spring drive.

FIGURE 3 is a sectional view of the central or body portion of the blade-carrying dart assembly.

FIGURE 4 is a part section view of the powered end of the tubular housing showing a pneumatic cylinder with its piston bearing against the central shaft of the dart assembly.

FIGURE 5 is a similar view showing an explosive cartridge in thrusting position against the trailing end of the dart's central shaft.

FIGURE 6 is a similar view showing a high pressure air tank inserted into the trailing end of the dart's central shaft in such manner as to provide rapid initial acceleration and continuing jet thrust behind the motionable assembly as it traverses the full width of the traveling web.

Referring to FIGURE 1, the upwardly traveling web **1** is deflectively in contact with the tubular web-spanning element **2** which may be either rigidly or cushionably supported in whatever manner best suits its function in any particular application. In transverse motion through the web-spanning barrel **2** and protruding from the lengthwise slot **3** is the severing blade **4**, shown slitting the traveling web **1** whose leading free end **5** is starting to fall away as it is severed.

FIGURE 2 shows one end of the web-spanning barrel **2** which is partially cut away showing the dart assembly **6** at rest inside the tubular enclosure **2**. The dart assembly **6** comprises a central shaft **7**, axially positioned within the barrel-like enclosure **2** by a webbed body **8** to which is affixed the severing blade **4**. The tube-contacting faces **9** of the dart's webbed body **8** are adequately clearanced so as to permit free flight through the barrel enclosure **2** and suitably dimensioned for axial stability and bearing surface area. Ideally the dart assembly **6** should be aerodynamically contoured and its webbed body **8** sparingly cross-sectioned so as to minimize air resistance to its bullet-like flight.

FIGURE 3 details one form of the dart assembly. Its body section **8** comprises three 120 degree segments between two of which the severing blade **4** is inserted. These several pieces are fastened together with machine screws **19**, clamping the body section **8** solidly against the matching undercut portion **20** of the dart's central shaft **7**, the thrust-bearing shoulders thus developed contributing measurably to the assembly's integrity in withstanding the shock loads to which it is subject.

High velocity propulsion may be achieved by mechanical, pneumatic or explosive means. One of the simpler mechanical forms is shown in FIGURE 2 wherein a compression spring **10** is adjustably preloaded by a rotatable plunger **11** thrusting against an anchor pin **12** which bears upon the inboard shoulder of a machined fast-leading acme-type groove **13** recessed **14** at spaced intervals to simplify step-loading and hold the plunger **11** at any given setting under load. The inboard end of the compression spring **10** through its dimpled thrust disc **21**, bears against the trailing end of the dart assembly's central shaft **7** which is axially bearinged in a supporting guide **15** and releasably held by a pivoted pawl **16** latched into the recess **17** in the central shaft **7**. For convenience in fabrication and maintenance, the thrust motor assembly may be enclosed within a cylindrical sleeve **22** in the manner illustrated.

Pneumatic propulsion may be achieved by means of pressurized air cylinder or bellows with quick release mechanism, or by ultra high pressure air meterably injected, utilizing techniques developed for use in air pistols and dart guns. FIGURE 4 illustrates a pneumatic thrusting arrangement in which figure, as in all the drawings, equivalent parts are similarly referenced, showing a rolling gland type of air motor including a cylinder **22**, rolling gland **23** and piston **21***a* bearing against the trailing end

of the dart's central shaft **7** which rests coaxially in the supporting guide **15***a*. This guide is webbed **24** or vented so that the piston **21***a* may travel forward as indicated to its phantomed position unrestricted by air cushioning. The several laterally motionable parts **7**, **21***a*, **23** are held releasably in their respective positions by the latching mechanism **16**, **17** which functions identically as hereinbefore described. This mechanism permits preloading the air motor with pressurized air **25** and the storage therein of potential energy identical in effect to cocking or preloading the compression spring **10**. In both examples it will be apparent that preloading the motor element permits instantaneous application of peak thrust against the dart assembly at its point of repose, or that from which its mass must be accelerated within milliseconds into a kinetically energized projectile capable of accomplishing its specified purpose. In order that the initial thrust be maximized, it is advantageous that the forward motion of the piston **21***a* be as unrestricted as possible, including the minimizing of its mass, wall friction and frontal air resistance. With respect to mass and friction, the order of preference among the several common types of air motors likely would be: metallic of Sylphon bellows, rolling gland (FIG. 4), standard air cylinder with sealed piston.

Although precluded from many applications due to potential fire hazard, explosive means for controlled-thrust propulsion would appear to be practical, one of the simpler forms being illustrated in FIGURE 5 in which a loaded cartridge **26** is chambered **22***a*, **11***b* at the outboard end of the web-spanning barrel **2** and positioned so as to deliver its explosive thrust to the central shaft **7***a* of the dart assembly when triggered by the firing pin **27**.

In the preferred form of the instant invention, thrust is applied to the central shaft **7** in which is concentrated the mass necessary to carry the dart assembly **6**, once kinetically energized, reliably to the opposite end of the slotted barrel **2**. The necessary mass thus becomes a direct function of the amount of work to be performed in its crossweb transit including frictional losses and web severance, and an inverse function of its velocity. In practical applications involving films and lightweight papers, especially at higher web speeds, the velocity of the dart assembly is the primary consideration. When applied to heavier-weight paper and board stocks both the mass of the dart assembly and the propulsion force must be increased.

Jet propulsion may also be used, with the power source carried within the dart assembly itself, e.g., by insertion of a high pressure cartridge. In such a jet-propelled system the mass of the flying dart assembly may be minimized since propulsion force continues throughout its crossweb flight, thus facilitating initial acceleration and high velocity transit. Acceleration may be aided further by cylindrical confinement of the initial gaseous expansion with the developing pressure exerting direct piston thrust which may be maximized by momentarily delaying release of the dart assembly.

The last described combination is illustrated in FIGURE 6 in which a high pressure cartridge **28** has been inserted into the hollow trailing end **29** of the dart's central shaft **7***b*, the assembly occupying a chamber **22***b* which may be glanded **30** near its inboard terminus. Inside the neck of the cartridge **28** is provided a membrane **31** which is pierced and orificed by the plunger **32** mounted in the end cap **11***b*. The plunger **32** may be designed to bleed a metered flow of air into the thrust pocket **25** when jabbed through the membrane **31**, or it may seal the pierced orifice in its forward stroke and permit escape of pressurized gas only when withdrawn. Once activated, the developing pressurization within the pocket **25** exerts positive thrust against the piston-like assembly **7***b*, **28** which may be restrained momentarily if desired by delayed release of the dart assembly, the use of the latching mechanism **15**, **16**, **17** being optional and its design subject to modification, including automatic release as a function of thrust exerted against it.

It will be apparent that this type of arrangement provides numerous alternatives by which each of the several factors affecting thrust may be adjusted so as to maximize performance with the least expenditure of energy. In practical terms, since the cost of compressed air per se is of little consequence, the net gain is to increase the range of utility of such an apparatus with respect to severing wider and more resistant webs, either or both being run at higher speed, and to perform with greater reliability.

Transit of the flying assembly should terminate cushionably, which may be accomplished by any one of several techniques known to and established in the art. The assembly may be held in the opposite end of the tubular enclosure or permitted to rebound back to its starting point and there retained.

Since a flying blade of the character herein described is a highly efficient severing instrument, and tragically so if one's hand were grasping the tubular enclosure when the blade was energized, it is advisable that the protruding edge of the blade be minimally exposed. Nor is greater protruding height advantageous in performing its function, assuming that the web is in physical contact with the severing device. The blade need not necessarily be sharp-edged except in certain critical applications, since its high velocity renders significant an otherwise insignificant mass such as that of a web of paper. Although under such light duty conditions the actual shaping of the severing blade **4** may not be critical, the profile **18** indicated in FIGURE 2 theoretically maximizes shear by its abruptness at its point of contact with the web, whereas a shallowly inclined slicing profile could negate the opposing shear force of the paper mass by inverting the blade's sinal advantage, thus demanding that web tension provide the necessary opposing force. Additionally when considering the effect of web flow at higher operating speeds and especially when thicker webs are being run, a gradually inclined profile would tend to scuff unless it were pitched slightly so that its deeper cutting sections followed precisely the cutting track. It should also be noted in connection with higher web speeds that the physical length of blade insertion and the consequent time interval during which it will tend to obstruct web flow gives further support to the abrupt profile, since its shortening reduces friction between the blade **4** and the slot **3** which develops as a function of traveling web force.

Although the slotted tubular form of the basic web-spanning element is preferred, the teachings herein contained are applicable to other forms of crossweb carriage for guidance and support of the flying blade assembly. It is conceivable that in certain applications a high-velocitied missile could be aimed precisely and fired transversely immediately adjacent the web's surface, performing its intended function by means of one or more severing fins without need for structural guidance in its crossweb transit. In fact, a bullet aimed dead center in the plane of web travel would surely accomplish web severance with minimal structural involvement. Although indisputably effective, the hazards inherent in on-guided and/or unshielded high velocity missiles preclude their being given serious consideration for most industrial applications. A cable-towed and mechanically supported slashing blade also may be used, driven either by high-speed winch or by parallel pneumatic cylinder oppositely directed, the latter permitting use of a complete bi-directional cable loop. This form of the device could be advantageous particularly in handling heavier paperboard since it is positively-powered throughout its crossweb transit without reliance upon kinetic energy or jet thrust.

To those skilled in the art it will be apparent that the methods herein outlined need not be restricted to tail cutting of an expiring web in connection with automatic paster or web splicing apparatus, nor necessarily to web severance exclusively, howbeit originally so purposed.

Having thus described my invention, what I claim and desire to secure by Letters Patent of the United States is:

1. In an apparatus of the character described for severing a continuous web while it is traveling at high speed, in combination with a transversely-motionable severing blade assembly and support means for its guidance crossweb,

a thrust motor forming a part of said apparatus, said motor having a motionable portion engaging said blade assembly, and

means to hold said assembly motionless in a starting, rest position while the motor is energized, and thereafter to release said assembly, allowing it to be thrust lengthwise of said support, said assembly being so contoured relative to said support means as to be minimally opposed by frontal air impaction in its crossweb traverse.

2. A device for severing a continuous web of paper traveling at high speed, comprising

(a) a transversely-motionable severing blade assembly,

(b) a support element providing guidance for crossweb transport of said assembly adjacent said web,

(c) means for storing latent, explosively activatable energy within said device, and

(d) means for explosively activating said energy into thrust sufficient to propel said assembly into high-velocities traverse of said web.

3. A device for severing a continuous web of paper traveling at high speed, comprising

(a) a transversely-motionable severing blade assembly,

(b) a support element providing guidance for crossweb transport of said assembly adjacent said web,

(c) jet power means for storing energy within said device, and

(d) means for release of said energy into thrust sufficient to propel said assembly into high-velocitied jet-powered traverse of said web.

References Cited by the Examiner

UNITED STATES PATENTS

943,221	12/1909	Engberg	83—614 X
1,446,404	2/1923	Tackaberry	83—614
1,555,391	9/1925	Surfus	83—614 X
2,331,342	10/1943	Perry	83—614 X
2,620,993	12/1952	Jeffrey	83—614 X
3,085,762	4/1963	Subklew.	

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