June 11, 1968 R. S. FUNK 3,387,548

AUTOMATIC MARKING AND CUTTING OF FLEXIBLE SHEETS

Filed Feb. 16, 1965 4 Sheets-Sheet 1

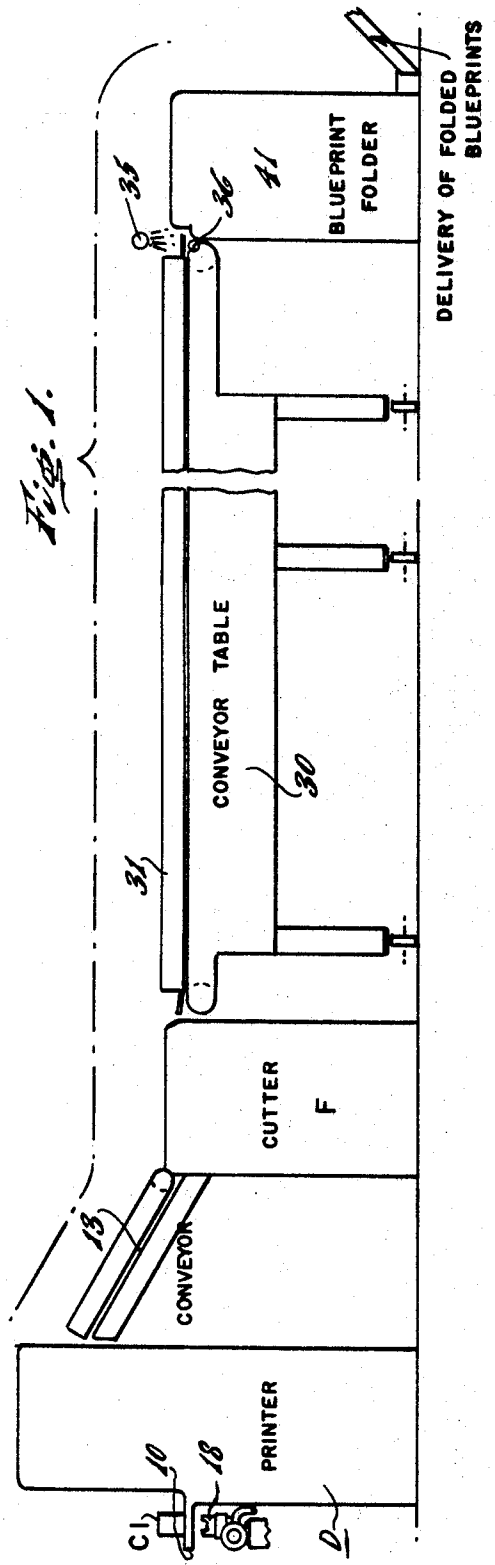


Fig. 1.

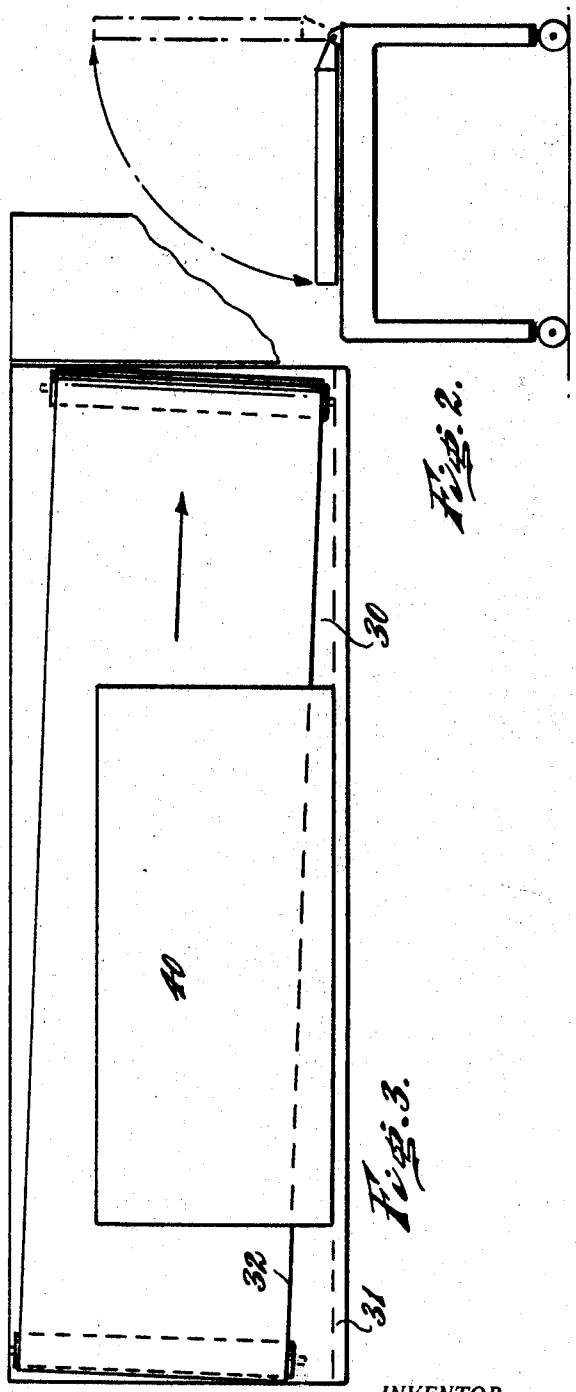


Fig. 2.

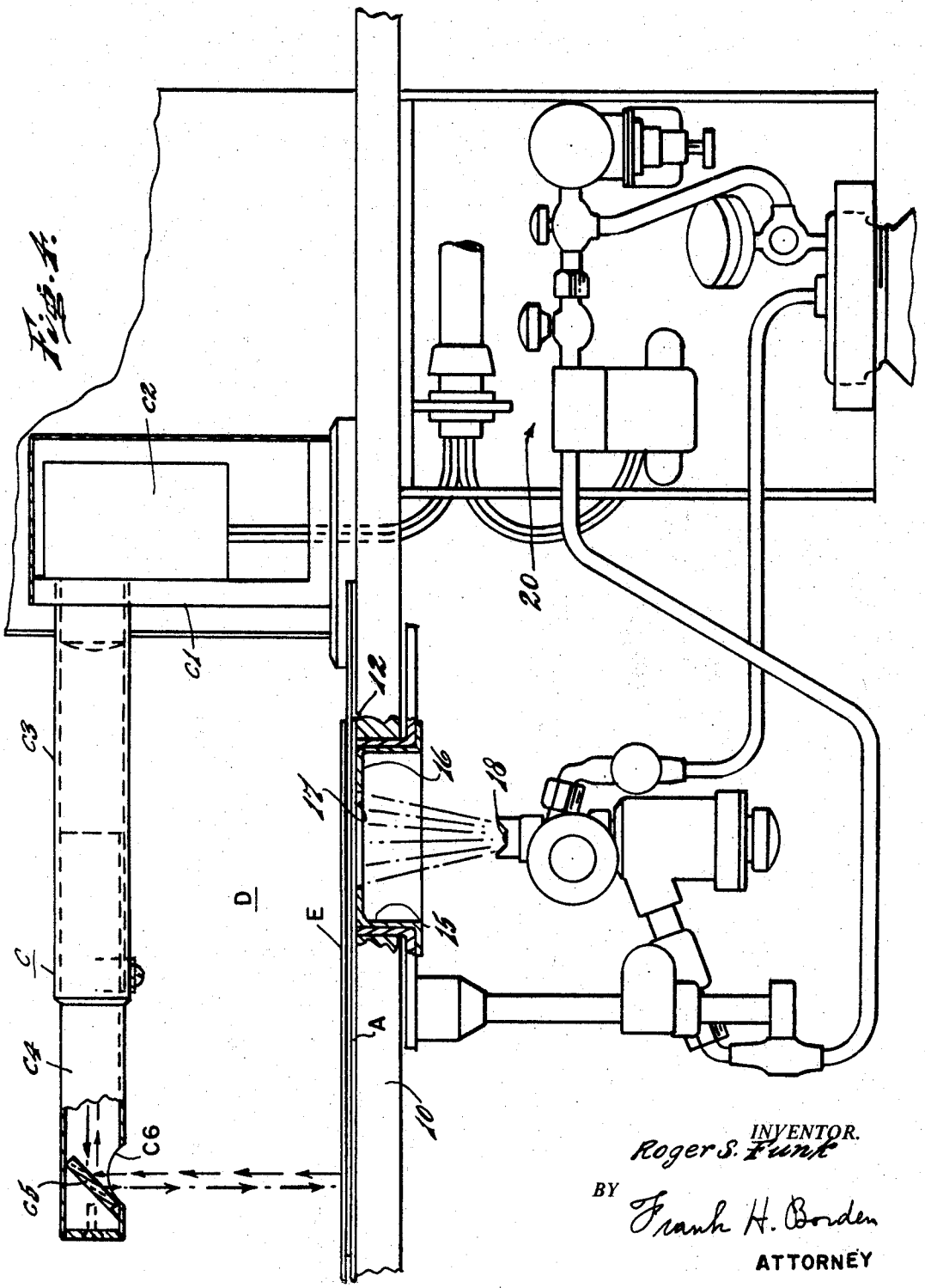
Fig. 3.

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AUTOMATIC MARKING AND CUTTING OF FLEXIBLE SHEETS

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AUTOMATIC MARKING AND CUTTING OF FLEXIBLE SHEETS

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Fig. 5.

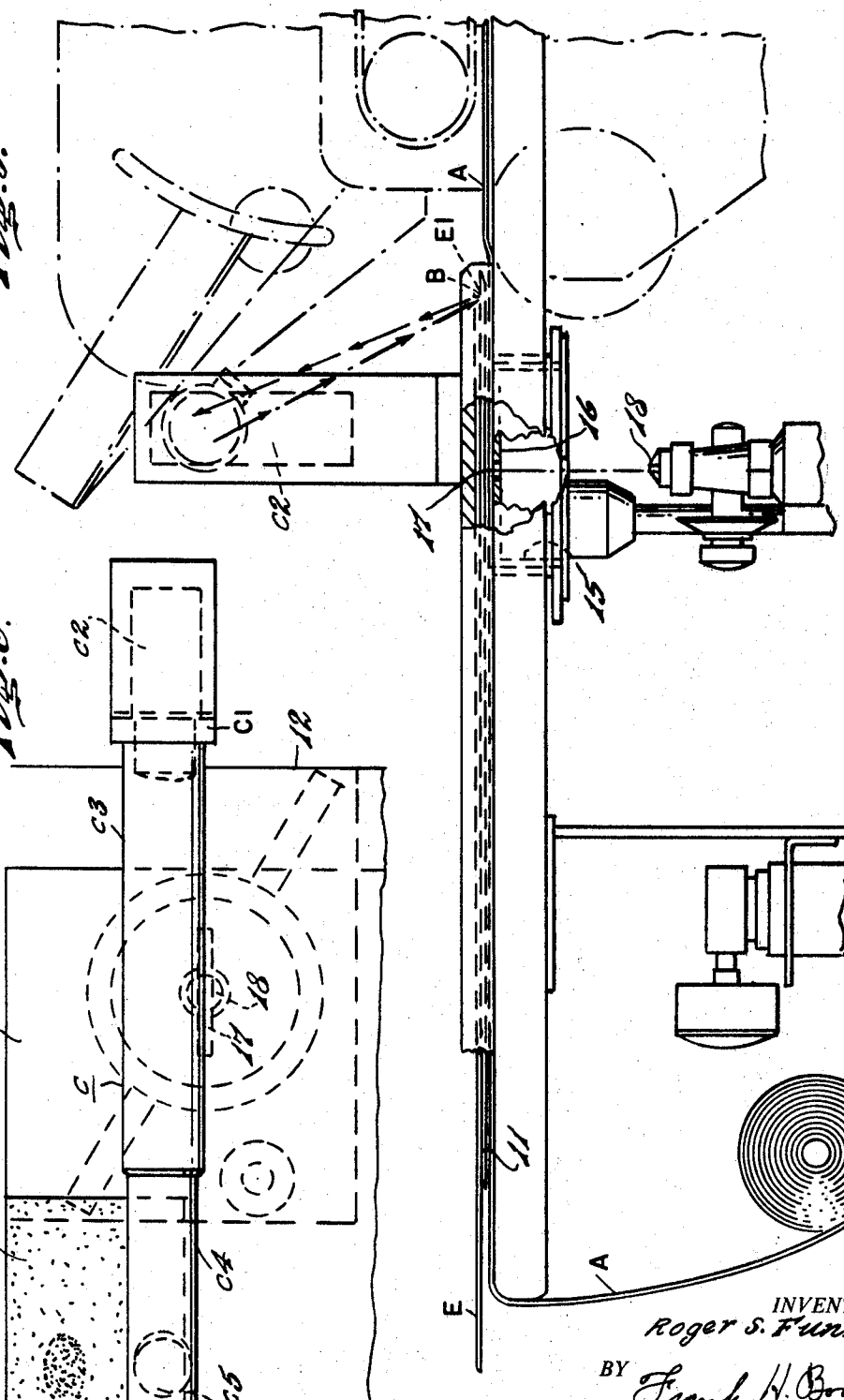


Fig. 6.

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AUTOMATIC MARKING AND CUTTING OF FLEXIBLE SHEETS

Filed Feb. 16, 1965 4 Sheets-Sheet 4

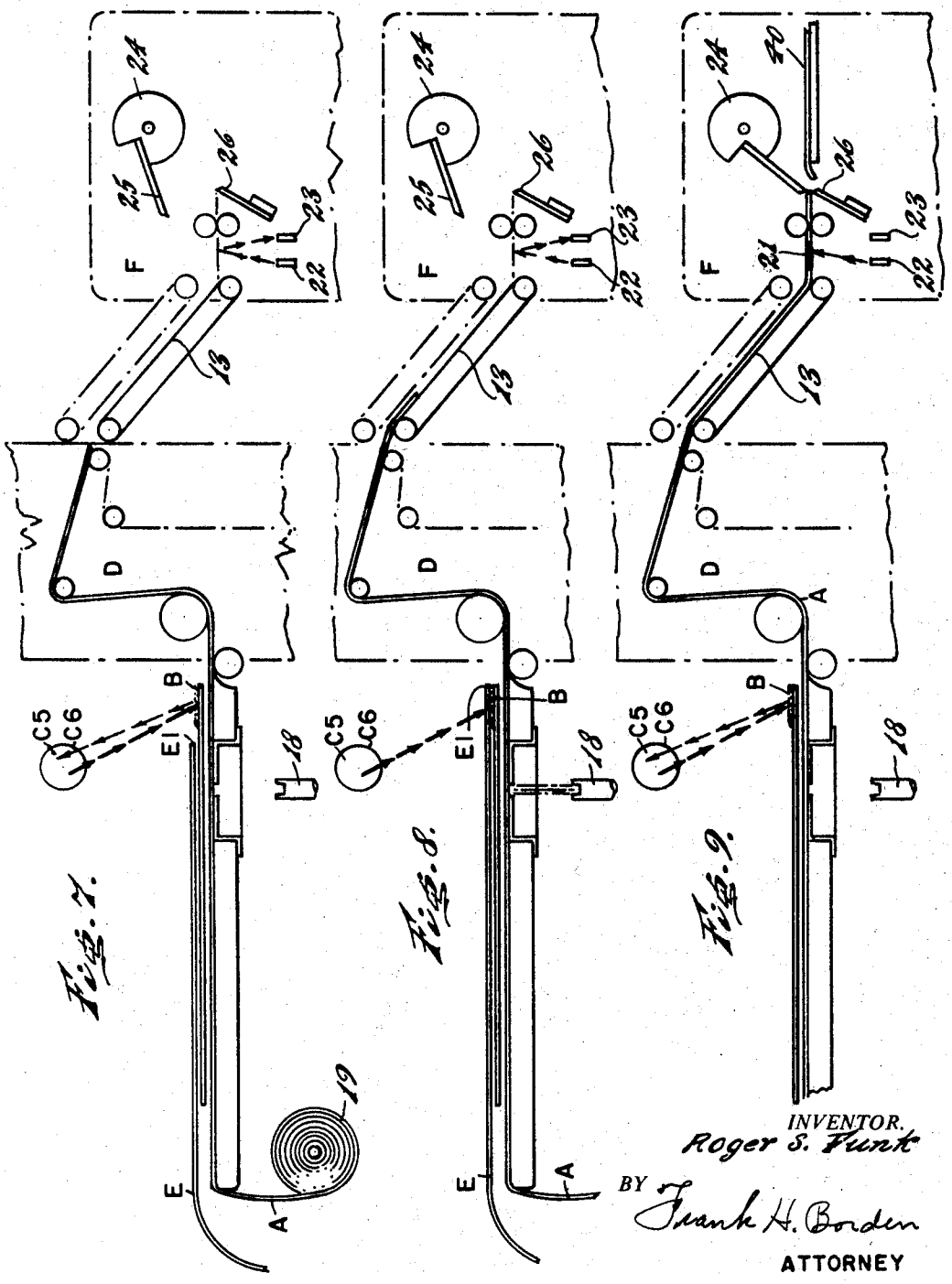


Fig. 7.

Fig. 8.

Fig. 9.

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AUTOMATIC MARKING AND CUTTING OF FLEXIBLE SHEETS

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9 Claims. (Cl. 95—73)

ABSTRACT OF THE DISCLOSURE

Apparatus for cutting prints from a traveling web according to the size of an original includes an optical sensing unit for sensing the leading edge of an original which is superposed on the traveling web as the web and original enter a printer, a marking device for marking the side of the web which is away from the original, a second optical device for sensing the mark as the web leaves the printer and a cutter controlled by the second optical device for severing the web in accordance with the position of the mark.

This invention relates to methods and apparatus for automatically marking and cutting printing stock to substantially accord with the lengths of associated tracings or the like.

While in some respects of general import, the specific illustrative exemplification is in blue-printing machines (preferably diazo or dry process whiteprint machines) and the like, in which master drawings or tracings or the like, called broadly reproducibles, in sheet form may have successively different lengths, and with which sensitive sheets are juxtaposed for printing, and automatically trimmed in length.

The invention is primarily concerned with the automatic marking of the web of stock sensitive paper entering a printing machine, in proper relation to the leading edge of an instant reproducible, and trimming said sensitive paper according to the marking into discreet sheets after printing is complete, and the instant section of exposed and developed sensitive paper has been discharged from the blueprint machine, thus making the entire blueprinting and trimming an automatic operation after the only manual operation of disposing and registering an instant master reproducible. The master sheet reproducible is disposed in temporary juxtaposed frictional contacting but partially spaced relation to an area of traveling sensitive sheet leading into the blue-printing machine.

The invention is also of interest and importance as providing means feeding the trimmed completed blue-print into a sheet-folding apparatus such as is disclosed in the U.S. patents to Funk, Numbers 3,052,464 and 3,117,777, whereby the entire operation, from manual insertion of a master reproducible or tracing into a printing machine, through completion of the blueprint, automatic trimming of the sensitive stock, and automatic folding of the delivered blue-print into a packet of predetermined lateral dimensions, is a continuous automatic operation.

In carrying out the invention in an illustrative embodiment the web of sensitive paper or sheet stock moves across a normally wide sheetwisely narrow feed table of any commercial printing machine responsive to the pull of rollers, belts or the like, in the printer, beyond the table, and passes under a shielding plate of appreciably smaller area than the feed table. The given master reproducible such as a tracing, usually of appreciable area, is positioned over said small plate and over the sensitive sheet passing across the feed table and manually pressed against the traveling sheet to move therewith inwardly of the apparatus, toward a retroflective surface on said shielding plate. An electrically controlled spray marking device is positioned below the small plate and below the sensitive sheet. A retroflective operating optical unit is disposed above the retroflective surface on said plate, having an optical axis intersecting the retroflective surface well inwardly of the right hand margin of the feed table and briefly energizes the marking device, as the leading edge of the master reproducible passes across the retroflective surface and intercepts the light beam of the retroflective unit. This places a sprayed mark of quick-drying characteristics on the lower surface of the sensitive sheet visually contrasting with the surrounding sheet, without affecting in any way the reproducible.

The marked sensitive sheet then passes through the printing machine with the reproducible, wherein the blueprint is formed on the sensitive sheet, and the latter alone passes down on a conveyor into an automatic cutter. As the continuous sensitive sheet progresses through said cutter the lower surface of the sheet is juxtaposed to an upwardly searching reflective photoelectric scanner. Interception of the latter by the visually contrasting applied mark energizes the automatic cutter, preferably of the single revolution type, to cut the exposed sensitive sheet at a given distance from said mark and thus establishes a leading edge at an end of said exposed sheet, while establishing the trailing edge of a severed preceding sheet or blueprint. The margin of the blueprint at its trailing edge depends upon the closeness with which a succeeding reproducible follows a preceding reproducible into the printer. When desired an additional mark can be applied to indicate the passing of the trailing edge or end of the reproducible in which case the waste sensitive sheet between prints can be cut out and disposed of.

It is among the objects of the invention:

To improve the art of blueprinting; to provide an apparatus and method for trimming sensitive stock to conform to the lengths of associated reproducibles; to provide a unified system for introducing a tracing or like reproducible and automatically completing the formation of a blueprint and the folding of the latter into a packet of predetermined dimensions; to provide means controlled by a tracing for applying a mark on sensitive stock in predetermined relation to an edge of such tracing; to provide means responsive to an applied mark on a sheet in translation for severing such sheet; to provide means for marking traveling stock material at one point in its travel and utilizing the applied mark at another point of its travel to sever the sheet; to fully mechanize a blueprinting system in order that one operator can print, cut and fold blueprints of varying lengths to correspond in length to reproducibles of random lengths; to provide a means of sensing the entry of a reproducible into a printing machine and of providing a corresponding mark on the sensitive printing material such that the reproducible is not subjected to physical contact or the possibility of damage or marking of any kind, and other objects and advantages will become more apparent as the description proceeds.

In the accompanying drawings forming part of this description:

FIG. 1 represents a schematic elevation of a series of illustrative components in an assembly by which introduction of a master reproducible or tracing results automatically in a folded blueprint of such reproducible delivered by the last component.

FIG. 2 represents a schematic section transverse of the conveyor feed table of FIG. 1.

FIG. 3 represents a plan of the conveyor feed table of FIG. 1, showing the diagonal disposition of the conveyor and an illustrative finished and severed blueprint aligned

with a marginal guide for aligned feeding into the sheet folding component.

FIG. 4 represents a fragmentary front elevation of a portion of a printing machine, say of 42" width, fitted with tracing-sensing and sheet-marking apparatus.

FIG. 5 represents a fragmentary side elevation of the section of the printer shown in FIG. 4.

FIG. 6 represents a partial or fragmentary plan of a portion of the printer table upon which is mounted the sensing and marking units.

FIG. 7 represents schematically and in skelatonized form a typical organization of printer and cutter showing in edge views the master tracing or reproducible, the lower-posed sensitive sheet and the intermediate plate before the tracing intercepts the retroflective system with the feed table in disproportionally exaggerated size.

FIG. 8 represents the same as the tracing intercepts the light beam of the retroflective system and energizes the marking device to provide a mark on the lower surface of the moving sensitive stock.

FIG. 9 represents the same sensitive stock translated by appropriate feeding means into the automatic cutter with the applied mark on the lower surface of the sensitive stock intercepting the lower photoeletcric sensing system, energizing the cutter.

Referring to FIG. 4 the section illustrates a feed table **10** leading into a blueprint or whiteprint machine D, on or across which table the sensitive paper A passes, in a direction normal to the plane of the sheet containing the figure. Mounted above and in closely spaced parallel relation to the table **10**, is a rigid plate **11** (FIGURE 5). The upper surface of plate **11** at a desired area, such as an inboard corner, mounts a strip of retroflective material B, for operative functional association with a retroflective sensing and signalling unit C. This latter comprises a vertical plate C1, mounting on its rear face a retroflective assembly C2 containing a light source and photoelectric devices, and is connected to a control chassis containing control relays. This unit illustratively may comprise an organization of photoelectric control and retroflective scanner such, for purely illustrative instance, as is described in Bulletin PA 621, dated January 1963, of the Photoswitch Division of Electronics Corporation of America, Cambridge, Mass. Other systems may be used. A feature of novelty is a rigid tube C3 mounted on the opposite face of the plate C1, concentric with the light transmitter and receiver of the retroflective assembly C2. The tube C3 extends parallel to the rigid plate **11** and feed table **10** and is in suitable spacing thereabove. Illustratively this spacing may be of the order of six inches, or so, to permit free passage of the operator's hand. A terminal tube C4 is telescoped into the tube C3 and internally mounts a frontal face mirror C5 at 45° to the axis of the tube and at 45° to the generally vertical sight axis radial of the terminal tube, concentric with a sight aperture C6 in the side of terminal tube. It will be understood that the terminal tube is so located that the sight aperture C6 is spaced far enough from the right hand margin of the table **10** that an operator's hand can pass beneath the tube C3 without passing under the sight aperture C6. It will further be understood that the terminal tube C4 is so disposed that the reflective sight axis centered through aperture C6 intersects the strip of retroflective material B, and the point of intersection can be moved fore and aft in the line of sheet feed, in a range of angular adjustments of terminal tube C4 and mirror C5, determined by the desired location of the signal mark on the lower face of the sensitive paper.

A lateral marginal guide line **12** is provided illustratively on the right side of the apparatus, to which printing paper A, feeding from a roll **19** (FIG. 7), below the feed table, is positioned, and the paper passes along the top of the feed table **10**, partially under plate **11**, and ultimately into the juxtaposed printing machine D.

Assuming that the sheet A is progressing across the feed table, and a tracing E, or like reproducible, assumedly a large reproducible, is placed upon the top of the printing stock A but overlying plate **11** in such manner that the lateral edge of the tracing above the plate is superimposed above the edge of the printing stock A below the plate **11** on the feed table **10** and coincident with guide line **12**. Being a large print or tracing E, most of the print surface is to the left of plate **11**, and the operator's left hand can compress the instant tracing against the moving printing paper A, which is progressing across the feed table thus progressing the reproducible E at the same rate of speed as the printing paper, and the operator's right hand can guide the often curled front edge of such reproducible against the upper surface of plate **11** and over and beyond same and ultimately with sheet A, into the printing machine D. This presents a condition in which the plate **11** is partially sandwiched between the tracing and the printing stock A, both of which later go in synchronism into the printing machine in the customary fashion.

In the course of motion of the reproducible E over the plate **11**, the leading edge E1 of the reproducible passes across the retroflective axis under the light beam thereof, reflected by the mirror C5 toward the layer or strip of retroflective material B, and intercepts same to such a degree that the changed retroflection against the mirror C5 and into the receiver or scanning unit C2 actuates a relay thereof.

The retroflective unit is such that its light source and receiving elements are mounted coaxially and when a light source within the scanner C2 is reflected by the mirror C5 it impinges against the retroflecting surface B, and the return beam reflected by the mirror C5 illuminates the coaxially mounted receiving elements in C2, and the photoelectric system functions, as normally evidenced by the holding or throwing of a relay contact or contacts within the photoelectric chassis connected in the scanning unit C2. The sensitivity of the unit is adjustable to detect lessor or greater amounts of radiant energy impinging upon the reeciver element.

There are two important characteristics of this system. One is that the retroflective light returns along the same path as the incident light, regardless of the angle at which the incident light strikes the retroflective strip B, thus permitting a wide range of angles relative to the normal, and the other is that this special optical system is so organized that it detects and utilizes reflective light without being affected by the outgoing beam.

Thus, when a tracing E is not being fed into the machine, or does not overlie the retroflective strip B, as in FIG. 7, the scanner detects the full value return of its own light beam as retroflected and mirror reflected, and has a corresponding affect upon its relay system. When, however, a reproducible E is introduced to the top of plate **11**, and of course upon the sensitive sheet A extending to the left thereof, and said tracing is advanced, normally, at the same rate of speed as the ingoing or infeeding sensitive printing paper, the leading edge E1 of the tracing, at some point, determined by the degree of rotation of the terminal tube C4 from that attitude at which the scanning axis is normal to the retroflective surface B, to an attitude at which the scanning axis is angularly displaced in the line of feed, intercepts the light beam impinging upon said retroflective sheet or layer as in FIG. 8, and a reduced degree of retroflected light is reflected by the mirror into the scanner, establishing a relay actuation used to actuate the marketing system to be described.

In the foregoing connection it may be noted that ordinary tracing paper will effect sufficient interception of the incident light as to control the relays of the retroflective system. The same is true of the newer polyester film base drafting media, such as Cronaflex, as these will also effect adequate light interception. The invention is therefore not limited to conventional tracing paper or the like, of the earlier art.

Before discussing the specific use of the marking on the lower surface of the printing sensitive paper, it may be noted that it is desirable to be able to adjust the location of the registration or activating mark, as the position of the mark is related to the rate of traverse of printing paper through the system, and the mark eventually determines the width of border adjacent to the leading edge of the print at the instant the sheet is cut, as will be described. The adjustment of location of the mark relative to the ultimate leading edge of the sensitive sheet is effected by rotating the terminal tube C4 and thus mirror C5 through a small range as mentioned above.

There are a number of instrumentalities associated with the feed table **10** having various important functions. At one point there is a cylindrical masking unit **15**, open at the bottom, and having an upper transverse closure **16**, the upper surface of which is generally in the plane of the upper surface of the feed table **10**. The transverse closure **16** contains an oblong slot **17** defining the mark **21** to be applied instantaneously to the lower surface of the moving sensitive sheet A, while shielding the other areas of the moving stock. Beneath and suitably aligned with the slot **17**, is the spray nozzle **18**, of a conventional commercial air brush actuated by the control system **20** controlled by the relay system of the retroflective unit C2. The spray unit emits an instantaneous pulse of very quick drying ink or the like (preferably black) which passes through the slot **17** against the lower surface of the sheet A, forming the identification mark **21**. The mark **21** effects a visual contrast to the surrounding area of the lower surface of sheet A. Note that the valuable tracing is always out of contact with the spray emission and is also protected by plate **11** and cannot be ruined or defaced by the spraying.

As the sensitive sheet A is moved in sheetwise feed through the printing machine, and then having been guided by suitable conveying devices **13** into an automatic cutter F to be described, it passes over and across a fixed beam from a light source **22**, normally reflecting from sheet A against a photoelectric receiver **23** or the like system having relays or controlled contacts or the like. When the dark mark **21** passes across the beam from the light source **22**, the reflection into the receiver **23** is diminished to such a degree as to actuate the relay system. The latter, through a solenoid, actuates a single revolution clutch in cutter organization F giving a fast rotation to a rotary cutter **24**, mounting blade **25**, moving transversely of the sheet A and relative to a fixed anvil cutter **26** mounted on the cutter frame. This action severs the sheet A at a predetermined distance from the identifying mark or spot **21**. The cut simultaneously establishes the trailing edge of a preceding print and the leading edge of the instant print.

It will be understood that the master reproducible or tracing enters the printer in superposed relation to the area of sensitive printing stock it overlies, and both are fed through the printer by suitable conveyors, belts or rollers or the like. After exposure in the printer the tracing takes a separate path away from the blueprint as is conventional.

The continuous web of sensitive paper upon which the print has been made, having been marked on its lower surface at **21** in proper relation to leading edge E1 of tracing E, passes on through the developing setion of the printer, through suitable conveyers and guides into the automatic cutter. Sensing of said mark and cutting as described above releases a cut sheet **40** of the printed sensitive stock of proper dimension on an aligning and feeding conveyer feed table **30**, mounting a longitudinal lateral upstanding guide **31**. A longitudinally misaligned conveyor belt **32** is provided for constant feed, upon which the completed blueprints **40** are deposited, and by the angularity of the conveyer belt are progressed laterally into guided relation to the lateral guide **31**, as shown in FIG. 3. Illustratively the delivery end of the conveyer feed table is provided with a light source **35**, the output of which traverse of the blueprint is beamed against a photoelectric unit **36** controlling the initiation of an automatic folding device **41**, as for instance an automatic folding device according to the said Funk patents.

It will be understood that with the apparatus running and all agencies energized, the operator simply inserts each of a series of master reproducibles or tracings of random size in the printing machine successively, in proper laterial alignment, as indicated in FIG. 7, until the leading edge passes under the light beam of the retroflective unit, as indicated in FIG. 8, energizing the spray to apply the mark to the traveling sensitive sheet. Thereafter, as indicated in FIG. 9, the mark is used to energize the cutter, and the instant sheet is chopped off at one end. Simultaneously the trailing edge of a preceding sheet is defined.

The advantages of the invention will be manifest simply as an improvement in blue-printing machines, as will the fact that with the assembly of components disclosed, for the first time a complete accurately folded blueprint can be produced by the mere insertion of a tracing.

It is important to note that with the elevation of one retroflective organization and the spacing of the focal axis laterally away from the side edge of the printer, the use of the system disclosed effects no changes from the conventional mode of introducing reproducibles into the printing apparatus, as there is complete freedom for the operator to manipulate sheets as usual. Further, as the reproducible in moving forward with the traveling sheet encounters no mechanical devices of any sort, but only a ray of light, and the spray device is intercepted by the thin plate **11** over which the reproducible passes, no possible damage of any sort can happen to the valuable reproducible.

I claim as my invention:

1. Apparatus for cutting traveling sheets of printing stock in accordance with the lengths of originals of varying sizes, comprising a feed table over which such stock travels, a plate in parallel spaced relation to said feed table, said plate providing clearance for the stock as it travels over said table, a retroflective strip on the upper surface of said plate, a retroflective scanning device having an optical axis incident on said strip, a stock marking device beneath said table controlled by said scanning device, whereby an original imposed over said traveling sheet and said plate and moving with said sheet intercepts said axis with its leading edge, said scanning device including means to energize said stock marking device in response to interruptions of a light beam projected by said scanning device along said optical axis to form a mark on the lower surface of such sheet in predetermined relation to said leading edge.

2. Apparatus as in claim **1** in which the scanning device incorporates an adjustable mirror whereby the angle of said axis to the strip of retroflective material is adjustable along the line of movement of such reproducible.

3. In a printer into which a traveling sheet of sensitive stock and a superposed reproducible are fed for printing the stock, a generally horizontal feed table for such stock, a generally parallel plate spaced above the feed table and fixedly mounted with respect thereto, said plate projecting over said table and providing a clearance for unrestricted movement of said stock, said plate being adapted to support a reproducible superposed thereon and on said stock and allowing for conjoint movement of the stock and reproducible relative thereto and into the printer, a retroflective unit having an axis parallel to said plate and being vertically spaced from said plate far enough to permit manual positioning of such reproducible over said plate with freedom, tube means concentric with said axis extending over said plate and mounting a frontal mirror at 45° to said axis and at 45° to a perpendicular of said plate, retroflective material on the upper surface of said

plate to be intersected by the mirror-reflected axis of the retroflective unit, a marking device mounted beneath said table and adapted to apply a distinctive mark to said stock at a point spaced beneath said plate and means including said retroflective unit for operating said marking device in response to interruptions of a light beam projected by said retroflective unit to said retroflective material.

4. Apparatus as in claim 3, in which the tube means is adjustable to change the angle of the frontal mirror relative to the perpendicular to said plate.

5. Apparatus as in claim 3 in which the tube means has such appreciable length that the mirror is adjustably displaceable laterally relative to said plate as to enhance the ability to position such reproducible without interception of said mirror-reflected axis by the hand of an operator.

6. In apparatus for making copies from originals of varying lengths, including a printer, mechanism for feeding a substantially continuous web of copy paper through said printer and a cutter adapted to be positioned adjacent the output of said printer for severing said web, the combination comprising; a substantially flat feed table adjacent the input of the printer, said table providing support for the web as it travels into the printer, a flat plate fixedly mounted above said feed table, said plate extending in parallel relationship to the surface of said table and being spaced therefrom to provide clearance for the web, said plate further being adapted to separate the web from an original superposed thereon as the web and original advance towards said printer, a retroflective material on the upper surface of said plate, a retroflective unit adapted to project a beam of light along an optical axis incident on said retroflective material, a marking device mounted beneath said table, said marking device being operative in response to interruptions of said light beam as the leading edge of an original covers said retroflective material to provide a visible mark on said web at a point on said web spaced beneath said plate.

7. Apparatus according to claim 1, further including optical sensing means for sensing said mark and a cutter responsive to detection of said mark by said sensing means for cutting said sheet along a line in predetermined spaced relationship to said mark.

8. Apparatus according to claim 7, wherein said marking device comprises an ink sprayer for spraying ink on the underside of said web along a line which impinges on said plate.

9. In apparatus for making copies from originals of varying lengths, including a printer, a device for feeding a substantially continuous web of copy paper through said printer and a cutter adapted to be positioned adjacent the output of said printer for severing said web, the combination comprising; a substantially flat feed table adjacent the input of the printer, said table providing support for the web as it travels into the printer, a flat cantilevered plate extending over said feed table in parallel relationship to the surface of said table and being spaced therefrom to allow passage of the traveling web, said plate providing for separation of the web from an original superposed thereon as the web and original advance towards said printer, a reflective material on the upper surface of said plate, an optical unit adapted to project a beam of light along an optical axis incident on said reflective material, a marking device mounted beneath said table, said marking device being controlled by said optical unit and being operative in response to interruptions of said light beam as the leading edge of an original covers said reflective material to provide a visible mark on said web at a point on said web spaced beneath said plate.

References Cited

UNITED STATES PATENTS

3,058,409 10/1962 Limberger ---------- 95—75

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