

[54] APPARATUS FOR APPLYING INDICIA TO
WEBS OF PHOTOGRAPHIC PAPER OR THE
LIKE

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425/174.6, 155, 289, 367, 374, 375, 385,
363, DIG. 200, DIG. 201, 143

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Primary Examiner—Robert L. Spicer, Jr.

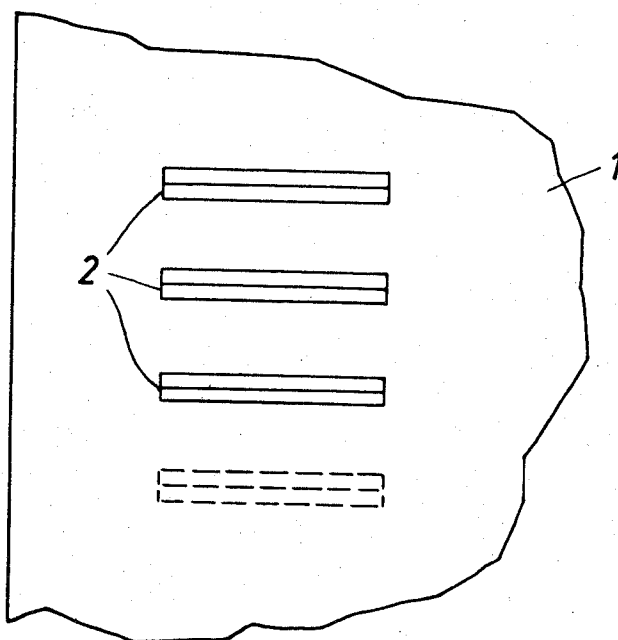
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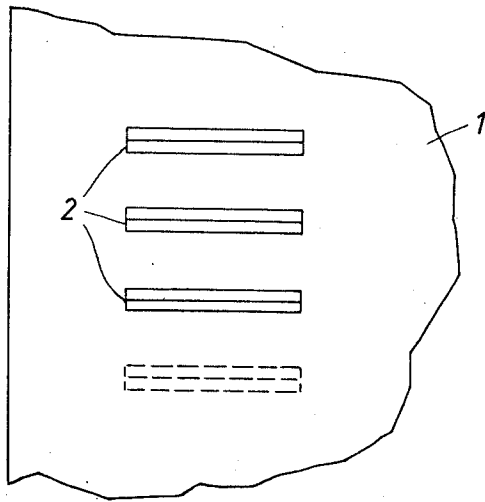
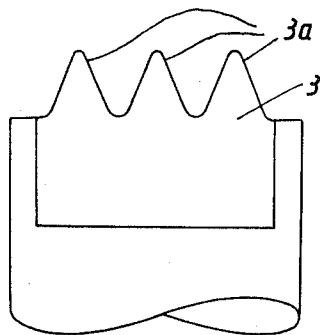
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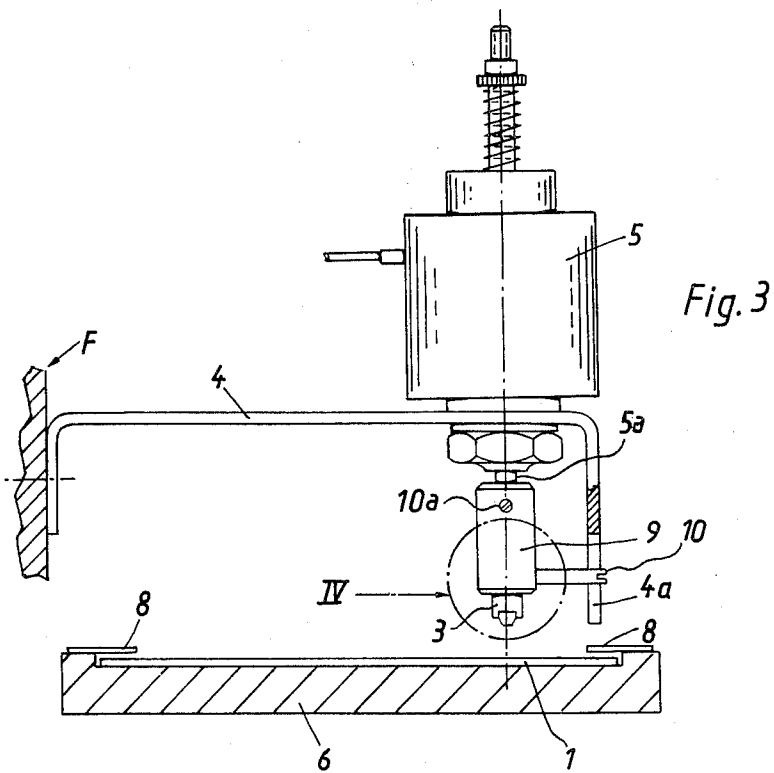
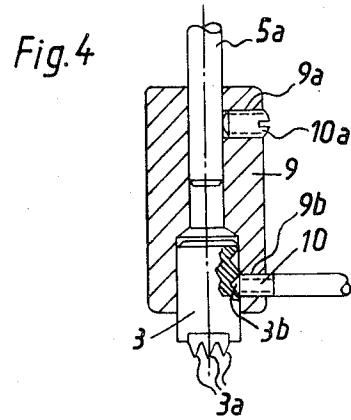
ABSTRACT

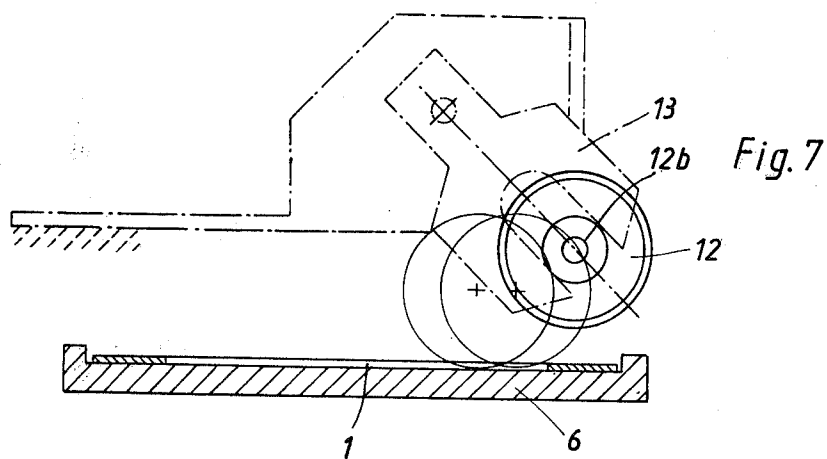
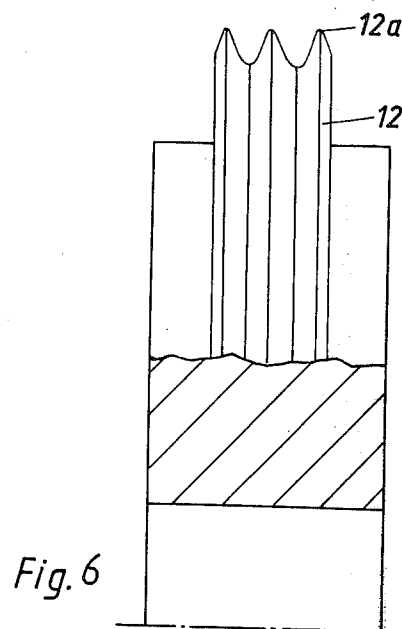
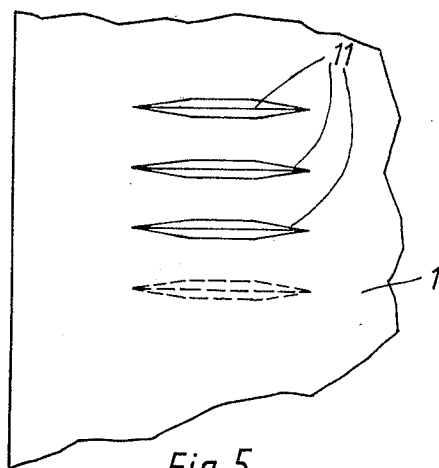
A web of photographic paper is provided with indicia in the form of parallel grooves which are impressed into the rear side of the web by a reciprocable or pivotable ram- or wheel-shaped tool having one or more projections in the form of teeth, ribs or rings. The grooves are deep enough to be detectable by a needle, elastically mounted blade or other mechanical scanning means which cooperates with a transducer serving to produce signals for actuation of a device which severs the web between neighboring prints or for actuation of an evaluating circuit which receives a signal upon detection of the last print forming part of a customer order. The grooves extend at right angles to the longitudinal direction of the web. The projections of the tool can be heated to insure the formation of lasting grooves even if the web is caused to pass through one or more liquid baths before it reaches the scanning station.

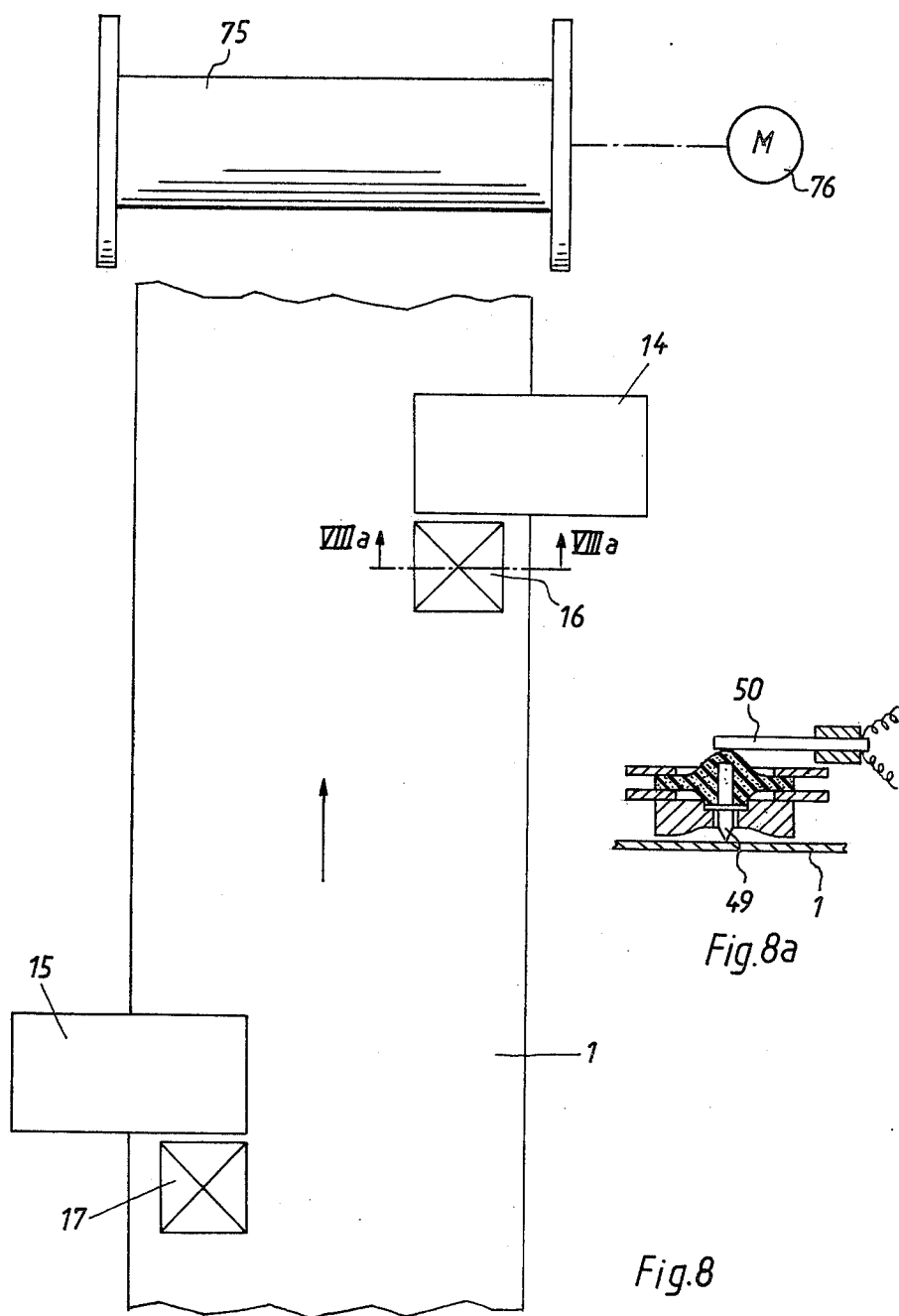
23 Claims, 13 Drawing Figures



*Fig. 1**Fig. 2*







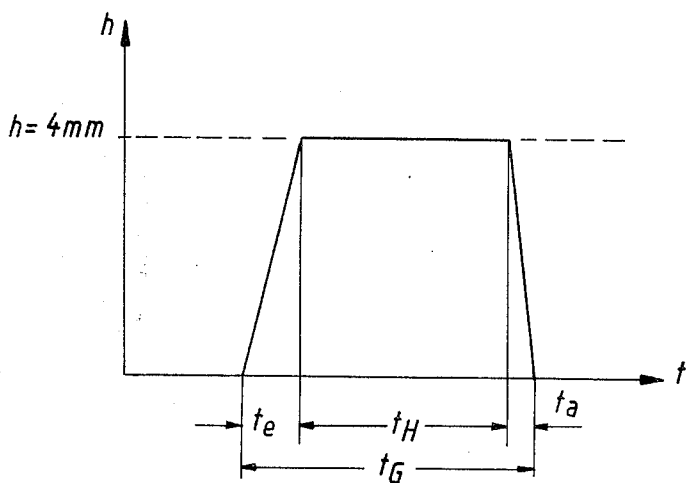


Fig. 10

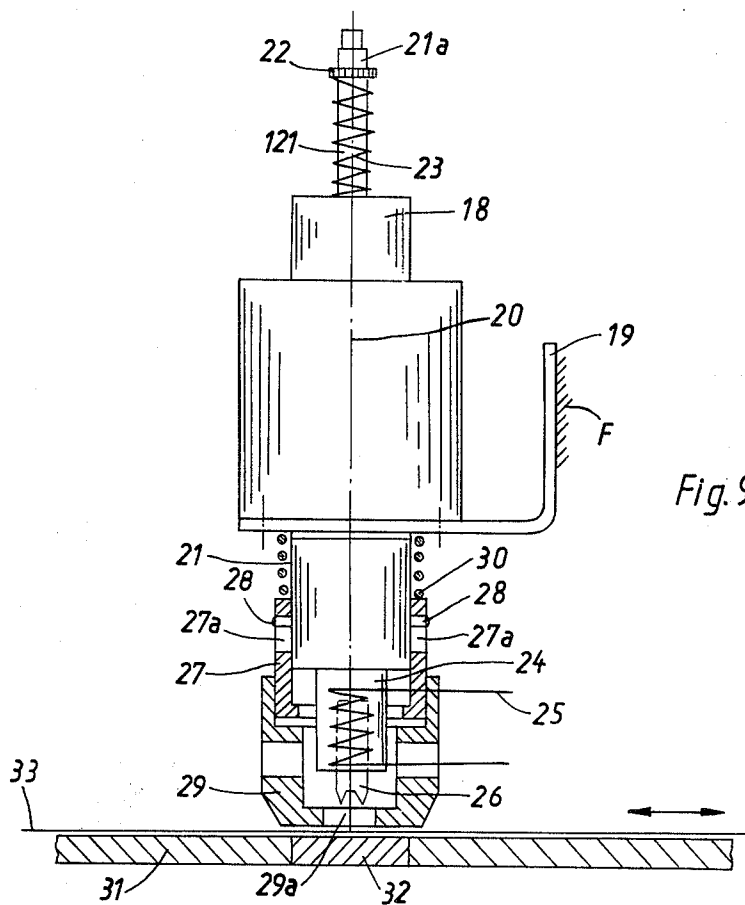
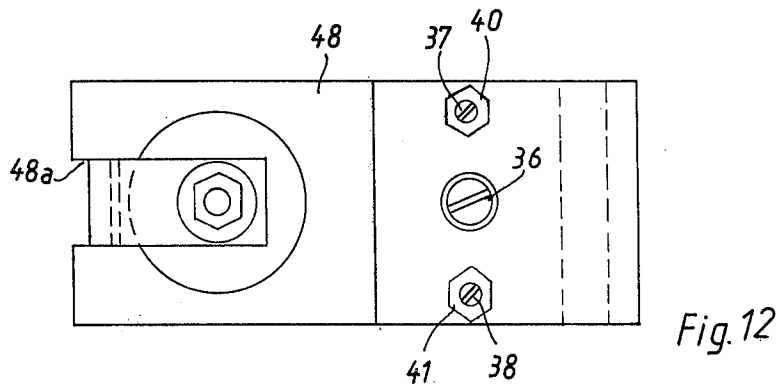
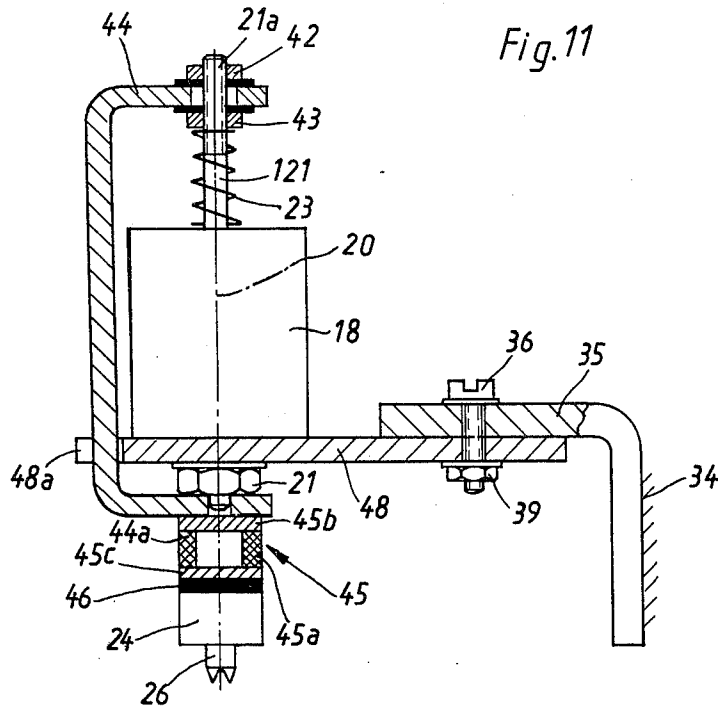


Fig. 9



APPARATUS FOR APPLYING INDICIA TO WEBS OF PHOTOGRAPHIC PAPER OR THE LIKE

BACKGROUND OF THE INVENTION

The present invention relates to apparatus for applying indicia to webs consisting of paper or other photographic film deformable material. More particularly, the invention relates to apparatus for applying automatically detectable indicia to webs of interconnected photographic prints for the purpose of initiating the operation of severing devices, counters and/or other signal responsive units in an automatic processing laboratory or the like.

It is well known to provide webs of interconnected prints with indicia in the form of graphite marks or notches which can be detected by photoelectric or other scanning means serving to actuate cutting or severing devices which subdivide the webs into discrete prints ready to be shipped to customers and/or dealers. Certain indicia serve to indicate the end of a customer order and/or the start of the next order. The position of each indicium with respect to the respective frame line (where the web is to be severed between two neighboring prints) is or should be such that the signal which is generated in response to detection of an indicium can be amplified and transmitted to the actuating means for a severing device so that the latter can sever the web across or close to the center of the respective frame line.

The just discussed indicia are of considerable help in insuring automatic or semiautomatic processing of films and/or prints in a laboratory, especially when the laboratory operates at maximum capacity (such as during and after the summer vacation period, following certain holidays and/or similar occasions when the customers send in or deliver extremely large numbers of exposed films for processing and making of prints).

As a rule, the indicia are applied to the rear side of a web of photographic paper the front side of which is coated with a photosensitive emulsion. Graphite marks are applied by a small wheel which is caused to contact the rear side of the web at intervals determined by the spacing of exposed frames on the corresponding photographic film. Such marks can be detected due to the fact that their light absorption is more pronounced than that of the unmarked portion of the rear side of the web and/or because their conductivity is different from that of the material at the rear side of the web. As mentioned above, such marks can be applied for the purpose of indicating the loci where a web is to be severed between neighboring prints and/or to indicate the last print of a particular customer order.

A drawback of graphite marks is that they are at least partially removed or blurred due to the fact that, after the application of graphite marks at or close to the printing station of a photographic copying machine, the web is caused to pass through one or more liquid baths before it reaches the severing station where the prints are separated from each other. It has been found that one or more wet treatments greatly affect the detectability of graphite marks so that they cannot be located with a requisite degree of reliability.

It was further proposed to expose indicia onto the emulsion-coated front side of a web of photographic paper and to use such indicia in the same way as graphite marks. The indicia are exposed adjacent to one or more edges of the respective prints and are detectable

by photoelectric scanning elements. Such indicia can be applied only to webs which are to be subdivided into discrete prints of the type having a white margin surrounding the image; however, they are evidently not suited for application to front sides of webs which are to be subdivided to yield so-called marginless or margin-free prints. Moreover, the presence of indicia in the form of exposed and developed dark spots at the front side of a web affects the appearance of the prints, especially if the severing operation is not carried out with a high degree of accuracy so that the distance between the exposed indicia and the respective edges of prints varies from print to print.

It was further proposed to provide webs of photographic material with indicia in the form of cuts of slits which are sufficiently pronounced to be readily detectable by photoelectric means. A drawback of such indicia is that they weaken the material of the web, especially during and immediately after one or more wet treatments, so that the web is likely to tear in the region of slits or cuts during lengthwise transport through and after it issues from one or more liquid baths. Moreover, such slits are observable at the front side of the web and affect the appearance of the prints, especially if the distance between the slit and the respective edge of the print varies from print to print due to insufficient accuracy of the severing operation. In other words, a discriminating customer is likely to object to the presence of slits, especially if the position of slits is not identical on all prints of a complete customer order.

The problems in connection with the application of indicia are further aggravated if the webs of photographic paper or the like are coated or impregnated with a film of synthetic plastic material. The plastic coating does not retain graphite marks so that such webs are normally provided with indicia in the form of exposed symbols and/or slits which exhibit the aforesaid drawbacks. Thus, there exists an urgent need for apparatus which can be resorted to in the processing of films, photographic papers or the like in order to insure the formation of durable (lasting) and readily detectable marks which do not exhibit the drawbacks of graphite marks, exposed marks, slits and/or similar presently known indicia.

SUMMARY OF THE INVENTION

An object of the invention is to provide a novel and improved apparatus for providing webs of photographic film, photographic paper or the like with readily detectable indicia which are not likely to disappear or to become blurred or less pronounced during further treatment of webs and which can be applied to such webs without affecting the appearance of the webs and/or without affecting the quality of information which is stored on the webs.

Another object of the invention is to provide an apparatus which can be utilized for the application of a wide variety of indicia each of which can be scanned for a different purpose and each of which can consist of a single mark or a group of two or more properly arrayed discrete marks.

An additional object of the invention is to provide the apparatus with one or more novel and improved indicia applying tools whose action is reproducible with a high degree of accuracy and which do not weaken the material of a web during the application of indicia and/or do

not affect the quality of information which is stored on the webs.

A feature of the invention resides in the provision of identifying selected portions of a web, e.g., a web of photographic paper having a first side which is provided with a photosensitive layer and a second side. The apparatus comprises means for subjecting the selected portions of the web to the action of a deforming force which produces in one side of the web indicia in the form of deformations (preferably lasting deformations) each of which is sufficiently pronounced to be detectable by a mechanical scanning element, e.g., by a needle of the type used in record players. The selected portions are preferably spaced apart, as considered in the longitudinal direction of the web, and each thereof may identify a discrete print of the web or the last print of a series of prints produced for a particular customer.

Each indicium may comprise one or more depressions, e.g., in the form of grooves, which are impressed into one side of the web by a heated or unheated tool movable into and from engagement with the one side of the web by an electromagnet, an eccentric or other suitable drive means. The depressions are preferably sufficiently lasting to be readily detectable by mechanical scanning means even if such mechanical scanning is preceded by a transport of the web through one or more liquid baths, for example, in an automatic developing machine. As a rule, the one side of the web is its second side, i.e., that side which is not coated with a photosensitive emulsion but which may be coated with a film of synthetic plastic material.

Each of the depressions is preferably of identical configuration and/or depth. For example, the depth of a depression in the form of a groove may equal or approximate one-fifth of the thickness of the web. Grooves of such depth can be readily detected by a needle or analogous mechanical scanning means.

Each deformation may constitute or include a slit or cut in the one side of the web; this is often desirable if the web is transported through one or more liquid baths prior to mechanical scanning of its indicia because the liquid can penetrate into the material of the web to thereby cause at least some swelling of material in the region of slits so that the indicia are even more readily detectable at the mechanical scanning station. Each of the indicia can be tested for quality (e.g., for depth, length and/or other characteristics) prior to mechanical scanning. Such testing is preferably carried out immediately downstream of the station where the indicia are being formed.

Each of the indicia may consist of two or more discrete deformations and the deformations of each indicium are preferably spaced apart from each other through predetermined distances. For example, if each indicium comprises two or more parallel grooves which are impressed into the rear side of the web, the distance between each pair of adjoining grooves may equal a predetermined distance and such grooves preferably extend transversely of the longitudinal direction of the web. The web can be provided with indicia while it is in motion or while it is at a standstill between two successive stepwise movements.

The making of indicia each of which consists of two or more discrete deformations in the form of grooves or the like is desirable because such indicia can be readily distinguished from accidental or unintentionally

formed deformations in the form of scratches, cracks or the like.

The novel features which are considered as characteristic of the invention are set forth in particular in the appended claims. The improved apparatus itself, however, both as to its construction and its mode of operation, together with additional features and advantages thereof, will be best understood upon perusal of the following detailed description of certain specific embodiments with reference to the accompanying drawing.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is a fragmentary plan view of the rear side of a web of photographic paper which is provided with indicia in the form of groups of three parallel grooves each;

FIG. 2 is an enlarged fragmentary elevational view of the working end of a tool which can be used to provide the web with indicia of the type shown in FIG. 1;

FIG. 3 is a partly elevational and partly vertical sectional view of an apparatus which embodies the tool of FIG. 2;

FIG. 4 is an enlarged axial sectional view of a detail within the phantom-line circle IV of FIG. 3;

FIG. 5 is an enlarged fragmentary plan view of the rear side of a web which is provided with modified indicia;

FIG. 6 is an enlarged fragmentary partly elevational and partly sectional view of a tool which can be used for the making of indicia of the type shown in FIG. 5;

FIG. 7 is a schematic partly elevational and partly vertical sectional view of an apparatus which embodies the tool of FIG. 6;

FIG. 8 is a plan view of a combination of two apparatus of the type shown in FIGS. 3 or 7, further showing two testing devices which are installed downstream of the respective apparatus and serve to monitor the condition or quality of freshly formed indicia.

FIG. 8a is a fragmentary sectional view as seen in the direction of arrows from the line VIIIa—VIIIa of FIG. 8;

FIG. 9 is a fragmentary partly elevational and partly vertical sectional view of a third apparatus which constitutes a modification of the apparatus shown in FIG. 3;

FIG. 10 is a diagram showing the length of intervals of contact between a web and the tool during the making of indicia;

FIG. 11 is a fragmentary partly elevational and partly vertical sectional view of an apparatus which constitutes a modification of the apparatus shown in FIG. 9, and further showing means for adjustably mounting the apparatus in a photographic copying machine; and

FIG. 12 is a plan view of the structure shown in FIG. 11.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

FIG. 1 is a greatly enlarged view of a portion of a web 1 which is provided with indicia (only one shown) in the form of groups of several discrete marks 2. Each mark 2 is an elongated straight groove which extends transversely of the longitudinal direction of the web 1 and is applied to the rear (uncoated) side of the web. The indicium shown in FIG. 1 is adapted to be mechanically scanned by a suitable feeler, e.g., a feeler similar to the needle of a record player, which produces signals

for actuation of a severing device (not shown) serving to sever the web across the frame lines between neighboring prints. The distance between the marks 2 which form an indicium is preferably small, for example, about 1 millimeter. The number of marks 2 which together constitute an indicium can be increased above three or reduced to two or one. More than two marks are preferred in order to enable a mechanical scanning device to discriminate between an indicium and a scratch or crack in the rear side of the web 1. Another safeguard against eventual actuation of the severing means in response to detection of a scratch or crack is the fact that indicia consisting of two or more marks 2 are regularly spaced along one marginal portion of the web 1. The scanning device including a needle-like or otherwise configured feeler can be readily designed to discriminate between regularly distributed groups of marks 2 and non-intentionally produced unevennesses at the rear side of the web. Each of the marks 2 shown in FIG. 1 is assumed to have a triangular cross-sectional outline, i.e., each such mark is assumed to be flanked by two narrow surfaces which make an acute, right or obtuse angle and meet in the deepest portion of the respective mark.

A tool 3 which can be used to provide the rear side of the web 1 with indicia of the type shown in FIG. 1 is illustrated in FIG. 2. The tool is provided with three parallel tooth-shaped projections or teeth 3a each having a rounded tip and each having two flanks which, in the embodiment of FIG. 2, make an acute angle (e.g., an angle of about 60°). The distance between the tips of the teeth 3a corresponds to the distance between the deepest portions of marks 2 of an indicium. The tool 3 may be made of hardened tool steel or of a metal exhibiting similar characteristics. Its teeth 3a undergo negligible wear, mainly due to the relatively low speed of movement of the tool 3 with respect to the web 1 during the making of marks 2. This renders it possible to utilize a single tool for a relatively long period of time without affecting the quality of marks 2. It is clear that, if desired, the tool 3 can be altered to provide the web 1 with indicia in the form of two or more rows of marks 2, in the form of marks which are staggered with respect to each other, as considered transversely of the longitudinal direction of the web 1, or which are distributed and/or configured in any suitable manner other than that shown in FIG. 1. All marks 2 need not have the same length, depth and/or width, and straight marks may be grouped with curved or otherwise configured marks. The flanks of teeth 3a on the tool 3 of FIG. 2 are preferably polished or otherwise treated to a high degree of finish.

FIG. 3 illustrates a grooving or mark-forming apparatus which embodies the tool 3 of FIG. 2. The apparatus is assumed to be installed in a copying machine having a frame or housing F which carries an inverted U-shaped bracket or support 4 for an electromagnet 5. The electromagnet 5 is installed at a level above a guide or support 6 for a web 1 which is assumed to be transported at right angles to the plane of FIG. 3. The upper side of the guide 6 has a shallow recess whose width only slightly exceeds the width of the web 1 so that the latter is held against excessive sideways movement to thereby insure that the marks applied by the projections 3a of the tool 3 are located at a predetermined distance from the right-hand marginal portion of the web. The guide 6 may be provided with elastic tongues

8 or other suitable means for biasing the web 1 against the upper side of the guide so that the plane of the web during travel below the electromagnet 5 is located at a predetermined distance from the tool 3 when the latter dwells in the retracted or inoperative position of FIG. 3.

The armature 5a of the electromagnet 5 carries a holder 9 for the tool 3. As shown in FIG. 4, the holder 9 is a sleeve having two radially extending tapped bores 9a, 9b. The bore 9a receives a screw 10a which serves to separably secure the holder 9 to the lower end portion of the armature 5a. The bore 9b receives an elongated externally threaded pin 10 having a rounded tip which can be received in a shallow notch 3b of the tool 3 to thus insure that the tool is located at a predetermined distance from the plane of the web 1 in the recess of the guide 6 as well as that the projections 3a are properly oriented with respect to the longitudinal direction of the web. As mentioned above, the tool 3 is intended to provide the web 1 with indicia consisting of groups of several elongated marks or grooves 2 each of which extends at right angles to the longitudinal direction of the web. In order to prevent accidental angular displacement of the holder 9 and the tool 3 therein, the outer portion of the pin 10 extends into a vertical guide slot 4a of the bracket 4.

When the electromagnet 5 is energized, the armature 5a moves downwardly, as viewed in FIGS. 3 or 4, and propels the tool 3 toward the exposed rear (upper) side of the web 1 in the guide 6. The kinetic energy of the descending tool 3 is selected with a view to insure that each of the marks 2 formed by the projections 3a of the tool has a predetermined depth, for example, 0.05 millimeter if the average thickness of the web 1 is about 0.25 millimeter. Since the marks 2 are relatively shallow (as compared with the average thickness of the web 1) the descending projections 3a are not likely to cause a pressure-initiated exposure of the photosensitive emulsion at the underside of the web 1. The likelihood of such exposure is further reduced due to the fact that the tool 3 is provided with several projections 3a so that the pressure to which the rear side of the web 1 is subjected when the electromagnet 5 is energized is distributed over a relatively large area. It is clear that the armature 5a can be designed to move the tool 3 downwardly in response to each deenergization of the electromagnet 5.

The extent of penetration of the projections 3a into the rear side of the web 1 can be regulated and changed in a number of ways. For example, one can control the current which is needed to energize the electromagnet 5. It is also within the purview of the invention to provide one or more mechanical stops which physically arrest the tool 3 in a predetermined lower end position when the tips of the projections 3a are located at a predetermined distance from the upper side of the guide 6. The just discussed mechanical stop or stops can be designed to abut directly against the upper side of the web 1 in the guide 6 to thereby increase the area of that portion of the web which is subjected to pressure in response to downward propulsion of the tool 3. An advantage of stops which bear against the web is that they can compensate for fluctuations in the thickness of the web below the electromagnet 5 to thus further reduce the likelihood of formation of marks 2 having different depths.

Accurate regulation of the minimum distance between the guide 6 and the tips of the projections 3a is desirable in most instances, not only to insure the formation of marks 2 having identical depths, widths and lengths but also to reduce the likelihood of pressure-induced exposure of the emulsion at the front side of the web 1 below the grooving station.

FIG. 5 illustrates a portion of a web 1 which is provided with different indicia each of which includes several parallel marks 11 in the form of combined slits and grooves 11 having varying widths and depths. The marks 11 can be formed by resorting to a tool 12 of the type shown in FIG. 6. This tool is a wheel having three circumferentially extending endless cutting or scoring projections or ribs 12a. The tool 12 can be caused to rotate relative to the web 1 in the recess of the guide 6 (see FIG. 7) whereby each of its projections 12a forms one of the three marks 11. The edge of each scoring projection 12a is preferably rounded as shown in the upper part of FIG. 6. The projections 12a need not sever the entire web 1; it is normally sufficient to insure that the projections 12a penetrate through the synthetic plastic layer which is often applied at least to the rear side of the web. When the web 1 is thereupon transported through one or more liquid baths, the liquid penetrates through the slits of marks 11 in the synthetic plastic coating and causes the material of the web to swell which contributes to the ease of detection of indicia including the marks 11.

The apparatus of FIG. 7 employs a wheel-shaped tool 12 of the type shown in FIG. 6. This tool is preferably mounted in the same way as the graphite wheel of a conventional marking apparatus. As shown, the tool 12 is rotatably mounted on a shaft 12b which can be moved along an arcuate path by a pivotable displacing member 13 (e.g., the armature of a rotary electromagnet) whereby the projections 12a of the tool 12 move toward and mark the rear or upper side of the web 1 in the guide 6. It is possible to dimension the tool 12 of FIG. 6 in such a way that it can be installed as a substitute for the graphite wheel in a conventional (existing) copying machine. This reduces the overall cost for conversion of a conventional machine into a machine which can be used for the practice of the present invention.

Apparatus similar to that shown in FIG. 7 (but using graphite wheels) are disclosed in German Offenlegungsschrift No. 1,497,384. This publication discloses that the wheel which is being pivoted by the armature 13 can be set in rotary motion during engagement with the web. Such rotation of a graphite wheel is considered necessary in order to produce a clearly defined graphite mark. When the apparatus of FIG. 7 pivots and rotates a tool of the type shown in FIG. 6, rotation during contact with the web 1 is advantageous because it insures that the projections 12a of the tool are more likely to sever the aforementioned synthetic plastic layer at the rear side of the web. Moreover, the rotating tool 12 is more likely to remove a portion of the plastic layer to thereby further enhance the likelihood of swelling of the thus scored web during travel through one or more liquid baths.

As mentioned above, the mechanical scanning device which serves to detect indicia consisting of one or more marks 2 or 11 may comprise one or more needles 49 mounted in a head similar to the tone head of a record player. It is also within the purview of the invention to

employ a yieldably mounted blade which extends at right angles to the direction of lengthwise movement of the web 1 at the scanning station. The blade is biased against the rear side of the web 1 in line with the row of indicia and is caused to penetrate into an oncoming mark 2 or 11 to thereby cause the generation of a preferably electric signal by resorting to an inductance, capacitance, piezoelectric crystal 50 or other suitable transducer means. Such transducer means can be used with equal advantage to produce electric signals in response to displacement of a needle 49 (FIG. 8a), i.e., when the tip of the needle penetrates into a mark 2 or 11.

FIG. 8 illustrates schematically certain parts of a copying machine which are used to provide the web 1 with two rows of indicia, namely, a first row of indicia which must be scanned to generate signals serving to actuate a severing device serving to subdivide the web 1 into a series of discrete prints, and a second row of indicia which must be scanned to generate signals serving to actuate one or more devices which must be actuated upon completion of a customer order. It is well known to use a single elongated web for the making of prints which are to be mailed to several customers. The signals which are generated on detection of second indicia are used to indicate that the prints obtained upon severing of the preceding portion of the web belong to a first customer and that the next-following prints belong to a different customer.

The apparatus 14 applies indicia which serve to actuate the severing device, and the apparatus 15 applies indicia at longer intervals because such indicia serve to indicate the last of a series of prints belonging to a given customer. As shown, the two rows of indicia are applied to different marginal portions at the rear side of the web 1.

The apparatus 14 and 15 are respectively followed by suitable testing or monitoring devices 16, 17 (each having a needle 49 and a signal transmitting element 50) which serve to examine the freshly applied indicia for quality and to arrest the drive means for the web 1 when the detected indicia are unsatisfactory. The testing devices 16, 17 can also serve to generate signals which are detected by the attendant who examines the indicia and adjusts the respective marking apparatus 14 or 15 if the indicia are unsatisfactory. The generation of visible or audible signals can take place simultaneously with stoppage of the drive for the web 1. It is clear that the testing devices (especially the device 16) can also serve to produce signals in response to failure of the respective apparatus 14 or 15 to produce indicia.

It has been found that indicia of the type shown in FIGS. 1 and 5 are readily detectable by relatively simple and inexpensive mechanical scanning devices and that the likelihood of confusion with unintentionally produced indicia (such as scratches or cracks in the rear side of the web 1) is remote, especially if each indicium consists of two or more marks. As mentioned before, the likelihood of confusion (especially in the case of indicia which serve to generate signals for actuation of the severing device) is further reduced due to the fact that the indicia recur at regular intervals.

The indicia which are produced by the apparatus 15 can be fed into a computer which is designed to furnish debit notes to the customer or to the dealer or which charges the account of a customer or dealer in accordance with the number and size of prints. Also, the sig-

nals which are furnished in response to detection of indicia produced by the apparatus 15 can be used to start an automatic collecting operation for the prints belonging to a customer or dealer. Such operation may include introduction of prints and the corresponding exposed and developed film or films into envelopes or other types of containers for shipment to the dealer or customer.

The drive means for moving the web 1 at a constant speed or stepwise comprises a takeup reel 75 (FIG. 8) and a motor 76 whose operation is synchronized with operation of the motor (not shown) which transports an exposed and developed film through the printing station where the images of successive film frames are projected onto the emulsion-coated front side of the web 1.

FIG. 9 illustrates a marking apparatus which constitutes a modification of the apparatus shown in FIGS. 3 and 4. The apparatus comprises an electromagnet 18 which is mounted on a bracket 19 secured to the frame F of the copying machine. The armature 21 of the electromagnet 18 is movable up and down and its axis 20 coincides with the axis of the tool 26 which is assumed to be identical with the tool 3 of FIGS. 3-4. An upwardly projecting extension 121 of the armature 21 is provided with external threads, as at 21a, and meshes with a knurled nut 22 which can be rotated to change the bias of a helical spring 23 reacting against the housing of the electromagnet 18 and urging the armature 21 upwardly, as viewed in FIG. 9.

That portion of the armature 21 which extends downwardly beyond the bracket 19 preferably consists of a heat-insulating material and carries a heating device or cartridge 24 including one or more electric heating coils 25. The circuit of the illustrated coil 25 includes a suitable thermostat (not shown) which regulates the temperature of the heating device 24 and hence of the tool 26 which is partially surrounded by the heating device. For example, the temperature of the heating device 24 may be between 110°-120° C., preferably about 115° C.

The lower portion of the armature 21 is further provided with two radially outwardly extending coaxial pins 28 which extend into vertical slots 27a provided therefor in a sleeve 27. The sleeve 27 is biased downwardly, as viewed in FIG. 9, by a helical spring 30 which reacts against the bracket 19. The extent to which the sleeve 27 is movable axially relative to the armature 21 or vice versa is determined by the length of the slots 27a. The sleeve 27 is provided with external threads (not specifically shown) meshing with the internal threads of a cupped hold-down device 29 whose axial position with respect to the sleeve 27 can be adjusted with a high degree of accuracy in response to rotation relative to the sleeve. The bottom wall of the hold-down device 29 has a central opening 29a through which the deforming projections of the tool 26 can extend to engage the rear (upper) side of the web 33 on the support or guide 31. The web 33 is movable in a direction to the left or to the right, as viewed in FIG. 9.

The guide 31 includes an insert or anvil 32 which is hard enough to avoid permanent deformation of its upper side if such upper side is struck by the working end of the tool 26 in the event that the tool descends while the anvil is not overlapped by a selected portion of a web 33. Eventual deformation of the upper side of the anvil 32 could result in exposure of the adjacent

portion of the photosensitive layer at the underside of the web 33 in response to pressure which develops when the armature 21 propels the tool 26 downwardly. The projections of the tool 26 extend at right angles to the plane of FIG. 9, i.e., at right angles to the direction of lengthwise movement of the web 33.

The axial position of the hold-down device 29 relative to the armature 21 is selected in such a way that the projections of the tool 26 remain slightly spaced apart from the upper side of the anvil 32 when the armature 21 is caused to descend and reaches its lower end position. During a first stage of downward movement of the armature 21, the spring 30 maintains the sleeve 27 in its lower end position relative to the armature so that the pins 28 are located in the upper end portions of the respective slots 27a. When the underside of the hold-down device 29 reaches the upper side of the web 33 in the guide 31, the armature 21 begins to move relative to the parts 27, 29 and the pins 28 begin to advance toward the lower end portions of the respective slots 27a. The downward movement of the armature 21 is terminated when the pins 28 enter the lower end portions of the respective slots 27a; the distance between the upper side of the anvil 32 and the tips of the projections on the tool 26 is then determined by the selected axial position of the hold-down device 29 relative to the sleeve 27 and by the thickness of the web 33 between the parts 32, 29.

The diagram of FIG. 10 shows that the distance h which the tool 26 must cover in a direction toward the guide 31 before the underside of the hold-down device 29 reaches the upper side of the web 33 in the guide 31 is about 4 millimeters. As the armature 21 continues to descend, the spring 30 begins to store additional energy and the tool 26 moves relative to the hold-down device 29 toward engagement with the upper side of the web 33. The length of the interval t_G during which the projections of the tool 26 actually engage and deform the web 33 is at least 25 and preferably about 35 milliseconds. The interval t_e denotes the time which is needed to cause the projections of the tool 26 to penetrate deepest into the upper side of the web 33; the interval t_u denotes the duration of withdrawal of the projections from the freshly formed marks or grooves, and the interval t_H denotes the period of dwell of the projections of tool 26 in their lower end positions at a minimum distance from the upper side of the anvil 32. It will be seen that $t_G = t_e + t_H + t_u$. Each of the intervals t_e and t_u is only a small fraction of the interval t_H .

It has been found that the projections of the heated tool 26 are much more likely to penetrate into and through the synthetic plastic film at the upper side of the web 33 than the projections of a cold (unheated) tool. In fact, the projections of the heated tool 26 melt the plastic film not later than upon completion of the interval t_H . Such heating of the tool 26 (by the heating device 24, 25 or by analogous heating means) renders it possible to produce in the web 33 permanent marks even if the force with which the armature 21 urges the tool 26 downwardly is very small. Also, and if the force which the armature 21 applies to the tool 26 is the same as in an apparatus using an unheated tool, the tool 26 is more likely to provide the upper side of the web 33 with deeper permanent marks whose configuration does not change during the interval which elapses between the making of such marks and the transport of marks to the station where the marks are mechanically

scanned for the purpose of generating electric signals which initiate the operation of the aforementioned severing device or the device or devices for reception of signals which indicate detection of the last print of a customer order.

The heating of tool 26 brings about another important advantage, namely, the distribution of pressures in the material of the web which is stressed by a heated tool is much more uniform than in a web which is subjected to the action of an unheated tool. This insures that the pressures which are transmitted through the major part of the web 33 and all the way to the emulsion at its underside are rather small and cannot result in pressure-induced exposure of the emulsion during the formation of marks. The temperature of the tool 26 need not be raised to the melting point of plastic material which coats the upper side of the web 33 in the guide 31; nevertheless, the quality of the marks which are produced with the tool 26 is much higher than that of marks which are formed by a cold or unheated tool. This is attributed to the fact that plastic deformation of the material of the web 33 constitutes a higher percentage of the overall deformation than when the deformation is caused by an unheated tool. Moreover, a mark which is produced by a heated tool is less affected by the fact that the web 33 must be conveyed through one or more liquid baths than a mark which is produced by an unheated tool. This insures that the marks can be readily detected and that the detected marks are capable of initiating the generation of satisfactory electric signals in spite of repeated wetting of the web prior to arrival of marks at the scanning station. As a rule, the sharpness of marks which are produced by resorting to a heated tool decreases negligibly subsequent to transport of the web through one or more liquid baths. Such liquid baths are provided at the developing station or stations through which the web 33 must be conveyed on its way from the exposure station of the copying machine to the severing station.

FIGS. 11 and 12 illustrate a presently preferred mode of adjustably mounting the improved marking apparatus in or on the frame of a copying machine. The apparatus can be installed in existing copying machines or during assembly of new copying machines. The nature of mounting of the apparatus in a copying machine is preferably such that the installation of apparatus in an existing machine necessitates the drilling of a small number of holes and/or relatively simple other operations which can be performed by semiskilled workmen. The adjustability of the apparatus is such that the tool 26 can be properly mounted with respect to the guide 31 (not shown in FIGS. 11 and 12) even if the holes, welded seams and/or the like are not machined or formed with a maximum degree of accuracy.

The electromagnet 18 of the marking apparatus is secured to a plate-like horizontal support 48 which is separably and adjustably secured to a sheet metal bracket 35 on the frame 34 of a copying machine. The coupling means comprises a centrally located screw 36 whose shank passes through aligned bores of the parts 48, 35 and whose lower end portion mates with a nut 39. The screw 36 is flanked by two adjusting screws 37, 38 which respectively mesh with lock nuts 40, 41. The external threads of the adjusting screws 37, 38 mate with the threads in tapped bores of the bracket 35. By rotating the screw 37 or 38 relative to the bracket 35, the operator can cause the tip of the screw 37 or 38 to

move the adjacent portion of the upper side of the support 48 further away from the underside of the bracket 35. Once the operator has selected a desired axial position of the screw 37 or 38, the lock nut 40 or 41 is applied to prevent unintentional changes in the inclination of support 48 relative to the horizontal portion of the bracket 35.

The upper portion or extension 121 of the armature 21 of the electromagnet 18 shown in FIG. 11 carries two lock nuts 42, 43 which flank the upper horizontal leg of a U-shaped yoke 44. The spring 23 reacts against the housing of the electromagnet 18 and bears against the lower nut 43 or against the upper leg of the yoke 44 to immediately lift the armature 21 as soon as the winding of the electromagnet 18 is deenergized. The vertically extending web of the yoke 44 is guided in an open slot 48a of the support 48 and the lower leg of the yoke 44 is connected to the armature 21 below the support 48. The slot 48a prevents excessive angular displacements of the yoke 44, armature 21 and tool 26 so that the projections of the tool are invariably held in proper orientation with respect to the longitudinal direction of the web, not shown in FIGS. 11 and 12. The lower end portion of the armature 21 extends into a bore 44a of the lower leg of the yoke 44. The position of the yoke 44 can be changed in the direction of the axis 20 by an appropriate adjustment of the axial positions of lock nuts 42, 43.

The heating device 24 for the tool 26 is mounted on the lower horizontal leg of the yoke 44 through the medium of an elastically deformable carrier 45. In the illustrated embodiment, the carrier 45 comprises a relatively short tube 45a consisting of rubber or the like and two metallic disks 45b, 45c which are respectively adjacent to the upper and lower axial ends of the tube 45a. The heating device 24 is secured to an insulating plate 46 which is affixed to the underside of the disk 45c. The axis of the carrier 45 preferably coincides with the axis 20 of the electromagnet 18.

The guide 31, its anvil 32, the sleeve 27 and the hold-down device 29 are omitted in FIGS. 11 and 12 for the sake of clarity.

The apparatus of FIGS. 11 and 12 can be mounted in a copying machine in the following way:

It is assumed that the vertical arm of the bracket 35 is parallel to the desired direction (axis 20) of reciprocatory movement of the armature 21. It is further assumed that the horizontal arm of the bracket 35 is normally located in a plane which makes an angle of 90° with the vertical arm of the bracket 35. If the axis 20 of the installed electromagnet 18 is not exactly normal to the plane of the web in the guide 31 below the tool 26, the plate-like support 48 which is rigid with the housing of the electromagnet must be tilted about a horizontal axis which intersects the axis of the screw 36. The nut 39 is loosened and the axial position of the screw 37 or 38 is changed to insure that the inclination of the support 48 will change as soon as the nut 39 is tightened again. The minimum distance between the projections of the tool 26 and the upper side of the anvil 32 in the guide 31 can be changed by moving the yoke 44 up or down relative to the armature 21 and by thereupon tightening the lock nuts 42, 43 to fix the yoke 44 (and hence the heating device 24 and tool 26) in the newly selected position. As a rule, the position of the yoke 44 relative to the armature 21 will be selected in such a way that the tips of projections on the

tool 26 remain slightly spaced apart from the upper side of the anvil 32 when the armature 21 reaches its lower end position. Minor deviations of the positions of projections on the tool 26 relative to the upper side of the anvil 32 can be compensated for by the resilient carrier 45. This carrier can compensate for the fact that a plane touching the tips of all projections on the tool 26 is not absolutely parallel to the plane of the upper side of the anvil 32. The carrier 45 yields sufficiently to insure that each projection of the tool 26 penetrates into the material of the web to the same extent so that the configuration of all simultaneously formed marks is identical.

The mounting of lock nuts 42, 43 at the upper end of the armature portion 121 is desirable because such nuts can be readily reached in an existing copying machine which is equipped with the improved marking apparatus.

It will be noted that the adjusting means 37, 38, 42, 43 enable an attendant to move the tool 26 in several directions, including up or down and sideways, so as to insure that the projections of the tool will engage selected portions of the web as well as that all marks will have the same depth, width and length.

The improved marking apparatus is susceptible of many additional modifications. For example, the electromagnet 5 or 18 can be replaced with an eccentric driven by a motor which completes one revolution whenever it receives a starting impulse. An advantage of such means for moving the tool is that the length of intervals during which the projections of the tool deform the web can be selected with a high degree of accuracy.

As mentioned before, the illustrated indicia are but a few examples of a large number of different indicia which can be applied to the web for the purpose of generating signals which are used to actuate a severing device or to actuate one or more devices which must be actuated upon detection of the last print of a customer order.

Without further analysis, the foregoing will so fully reveal the gist of the present invention that others can, by applying current knowledge, readily adapt it for various applications without omitting features which fairly constitute essential characteristics of the generic and specific aspects of our contribution to the art and, therefore, such adaptations should and are intended to be comprehended within the meaning and range of equivalence of the claims.

What is claimed as new and desired to be protected by Letters Patent is set forth in the appended claims.

1. Apparatus for identifying selected portions of a web of photographic paper of the type having a first side provided with a photosensitive layer and a second side, comprising guide means for supporting a web, whose temperature at least approximates the ambient temperature, so that one side of a selected portion of the web remains exposed; a marking tool reciprocable with respect to said guide means between a retracted position and an operative position in which a portion thereof penetrates into the one side of the selected web portion in said guide means whereby said portion of said tool subjects the selected portion to the action of a deforming force which produces in the one side of the web an indicium in the form of at least one recess which is sufficiently deep to be detectable by mechani-

cal scanning means; and means for moving said tool between said positions thereof.

2. Apparatus as defined in claim 1, further comprising means for moving the web lengthwise so as to place successive selected portions of the web into register with said tool.

3. Apparatus as defined in claim 1, wherein said means for moving said tool comprises an electromagnet.

4. Apparatus as defined in claim 1, wherein said portion of said tool comprises a plurality of projections each of which provides said one side of the web with a discrete recess in said operative position of said tool.

5. Apparatus as defined in claim 1, further comprising means for limiting the extent of penetration of said portion of said tool into the one side of the web in said guide means so that each recess of an indicium has a predetermined depth.

6. Apparatus as defined in claim 1, wherein said means for moving said tool comprises an electromagnet.

7. Apparatus as defined in claim 1, wherein said tool comprises a wheel and said means for moving said tool between said positions comprises a rotary electromagnet.

8. Apparatus as defined in claim 7, wherein said electromagnet is arranged to rotate said wheel in said operative position of said wheel.

9. Apparatus as defined in claim 1, wherein said portion of said tool comprises at least one tooth-shaped projection.

10. Apparatus as defined in claim 9, wherein said projection has two flanks making an angle of substantially 60° and a rounded tip.

11. Apparatus for identifying selected portions of a web of photographic paper or the like of the type having a first side provided with a photosensitive layer and a second side, comprising guide means for supporting a web so that one side of a selected portion of the web remains exposed; a marking tool movable with respect to said guide means between a retracted position and an operative position in which a portion thereof penetrates into the one side of the selected web portion in said guide means whereby said portion of said tool subjects the selected portion to the action of a deforming force which produces in the one side of the web an indicium in the form of at least one deformation which is sufficiently pronounced to be detectable by mechanical scanning means; means for moving said tool between said positions thereof; means for moving the web lengthwise so as to place successive selected portions of the web into register with said tool; and testing means for monitoring successively formed indicia prior to mechanical scanning.

12. Apparatus as defined in claim 11, wherein said testing means comprises means for producing signals in response to detection of unsatisfactory indicia.

13. Apparatus for identifying selected portions of a web of photographic paper or the like of the type having a first side provided with a photosensitive layer and a second side, comprising guide means for supporting a web so that one side of a selected portion of the web remains exposed; a marking tool movable with respect to said guide means between a retracted position and an operative position in which a portion thereof penetrates into the one side of the selected web portion in said guide means whereby said portion of said tool sub-

jects the selected portion to the action of a deforming force which produces in the one side of the web an indicium in the form of at least one deformation which is sufficiently pronounced to be detectable by mechanical scanning means; means for heating said tool; and means for moving said tool between said positions thereof.

14. Apparatus as defined in claim 13, wherein said heating means comprises a device for maintaining said tool at a temperature of 110°-120°C.

15. Apparatus as defined in claim 13, wherein said heating means comprises means for maintaining the temperature of said tool within a predetermined range of temperatures.

16. Apparatus for identifying selected portions of a web of photographic paper or the like of the type having a first side provided with a photosensitive layer and a second side, comprising guide means for supporting a web so that one side of a selected portion of the web remains exposed; a marking tool movable with respect to said guide means between a retracted position and an operative position in which a portion thereof penetrates into the one side of the selected web portion in said guide means whereby said portion of said tool subjects the selected portion to the action of a deforming force which produces in the one side of the web an indicium in the form of at least one deformation which is sufficiently pronounced to be detectable by mechanical scanning means; and means for moving said tool between said positions thereof, including means for maintaining said portion of said tool in contact with the web in said guide means for an interval of at least 25 milliseconds.

17. Apparatus for identifying selected portions of a web of photographic paper or the like of the type having a first side provided with a photosensitive layer and a second side, comprising guide means for supporting a web so that one side of a selected portion of the web remains exposed; a marking tool movable with respect to said guide means between a retracted position and an operative position in which a portion thereof penetrates into the one side of the selected web portion in said guide means whereby said portion of said tool subjects the selected portion to the action of a deforming force which produces in the one side of the web an indicium in the form of at least one deformation which is sufficiently pronounced to be detectable by mechanical scanning means; means for moving said tool between said positions thereof; support means; and means for adjustably securing said tool and said means for moving said tool to said support means so that the tool is adjustable in a plurality of directions with respect to said support means.

18. Apparatus as defined in claim 17, wherein said guide means comprises an anvil having a side adjacent

to the other side of a selected portion of a web in said guide means, said adjusting means being arranged to change the minimum distance between said portion of said tool and said side of said anvil in said operative position of said tool.

19. Apparatus as defined in claim 17, wherein said tool is reciprocable between said positions thereof and said adjusting means comprises means for changing the inclination of said tool relative to said guide means.

20. Apparatus for identifying selected portions of a web of photographic paper or the like of the type having a first side provided with a photosensitive layer and a second side, comprising guide means for supporting a web so that one side of a selected portion of the web remains exposed; a marking tool movable with respect to said guide means between a retracted position and an operative position in which a portion thereof penetrates into the one side of the selected web portion in said guide means whereby said portion of said tool subjects the selected portion to the action of a deforming force which produces in the one side of the web an indicium in the form of a deformation which is sufficiently pronounced to be detectable by mechanical scanning means; means for moving said tool between said positions thereof; and elastic carrier means interposed between said tool and said means for moving said tool between said positions thereof.

21. Apparatus for identifying selected portions of a web of photographic paper or the like of the type having a first side provided with a photosensitive layer and a second side, comprising guide means for supporting a web so that one side of a selected portion of the web remains exposed; a marking tool movable with respect to said guide means between a retracted position and an operative position in which a portion thereof penetrates into the one side of the selected web portion in said guide means whereby said portion of said tool subjects the selected portion to the action of a deforming force which produces in the one side of the web an indicium in the form of at least one deformation which is sufficiently pronounced to be detectable by mechanical scanning means; means for moving said tool between said positions thereof; and a hold-down device arranged to engage the one side of a selected portion of the web in said guide means, at least in said operative position of said tool.

22. Apparatus as defined in claim 21, wherein said hold-down device surrounds said tool, at least in said operative position of said tool.

23. Apparatus as defined in claim 21, further comprising resilient means for biasing said hold-down device against the one side of the web in said guide means in said operative position of said tool.

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