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(71) Demandeur/Applicant:
ARROW COATED PRODUCTS LTD., IN
(72) Inventeurs/Inventors:
PATEL, SHILPAN PRAVINCHANDRA, IN;
THANAWALA, NIKITA KAMLESH, IN
(74) Agent: GOWLING LAFLEUR HENDERSON LLP

(54) Titre : PROCEDE DE FABRICATION D'UN FILM HAUTE SECURITE ET FILM HAUTE SECURITE AINSI OBTENU
(54) Title: METHOD OF PRODUCING A HIGH SECURITY FILM AND HIGH SECURITY FILM PRODUCED BY THE SAID
METHOD

(57) **Abrégé/Abstract:**

The invention relates to a high security film, optionally in the form of a slit thread or a micro tape, which is then inserted into high security paper such as a bank note paper and the like during the paper making process. The invention envisages a novel method of producing such a high security film using a print transfer method, wherein one or more security features are incorporated on one or more indicia including letters, optionally graphics, during such a production process, using multiple printing stations and lamination.

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(71) Applicant (for all designated States except US): **ARROW COATED PRODUCTS LTD.** [IN/IN]; 5-D, Laxmi Industrial Estate, New Link Road, Andheri (West), Mumbai 400 053, Maharashtra (IN).

(72) Inventors; and

(75) Inventors/Applicants (for US only): **PATEL, Shilpan, Pravinchandra** [IN/IN]; A-303, Suman Apts., III Cross Lane, Lokhandwala Complex, Andheri (West), Mumbai 400 053, Maharashtra (IN). **THANAWALA, Nikita, Kamlesh** [IN/IN]; B-601, Sharda Gram, Mathuradas Road, Kandivali (West), Mumbai 400 067, Maharashtra (IN).

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(54) Title: METHOD OF PRODUCING A HIGH SECURITY FILM AND HIGH SECURITY FILM PRODUCED BY THE SAID METHOD

(57) Abstract: The invention relates to a high security film, optionally in the form of a slit thread or a micro tape, which is then inserted into high security paper such as a bank note paper and the like during the paper making process. The invention envisages a novel method of producing such a high security film using a print transfer method, wherein one or more security features are incorporated on one or more indicia including letters, optionally graphics, during such a production process, using multiple printing stations and lamination.

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Method of Producing a high security film and high security film produced by the said method

Field of Invention

5 The invention relates to a high security film, optionally in the form of a slit thread or a micro tape, which is then inserted into high security paper such as a bank note paper and the like during the paper making process. The invention envisages a novel method of producing such a high security film using a print transfer method, wherein one or more security features are incorporated on one or more indicia including letters, optionally
10 graphics, during such a production process, using multiple printing stations and lamination.

Background of the invention:

Security films and slit micro tapes are well known to the industry. These are known as
15 security thread also. This "thread" can be seen embedded almost in most of the currency paper. The process of manufacture and its insertion is also well known for many years. The following patents describe various types of security threads and the process of their insertion into the paper.

20 US patent 5002636 describes a method of making security paper comprising the steps of providing a strip of plastic material; applying a soluble pigmented material on said plastic strip; applying a layer of metal over said soluble pigmented material; printing over said metal with an insoluble pigmented material to provide printed indicia; removing said metal and said soluble pigmented material from said plastic strip except from under said
25 printed indicia to form a security thread; and embedding said security thread in a colored paper.

The security strip of the above patent requires a protective layer of plastic material over said security thread prior to embedding said security thread in said paper. Also, the removal of said metal and said soluble pigmented material includes steps of either ethyl

alcohol etching or incase of a water soluble pigmented material will include the steps of water dissolution. Hence, the process is quite complex and consumes a lot of time

5 US Patent 4761205 describes a method of forming a security paper by inserting the said security thread within paper fiber slurry at a predetermined location in a papermaking machine during dewatering of said fiber slurry before said fiber is consolidated into a continuous paper web. The said security thread is formed either by printing indicia on the said metalized plastic film by the help of a varnish resistant to metal reactive solvent and then subjecting the film to a metal reactive solvent; or hot stamping metallic indicia onto
10 a plastic film; or by selectively metalizing metal indicia onto a continuous planar plastic film; or by transferring metal indicia from a substrate onto a continuous plastic film.

However, it has been found that these types of products can be simulated by counterfeiterers, by virtue of the increased availability of technology.

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US patent 4552617 relates to thin strips of a carrier material, microprinted identifying indicia, which dissolves during the dewatering and drying stage of the paper making process. The microprinted indicia remains intact and is readable by means of transmitted light yet is neither legible nor reproducible with reflected light.

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However, these films whether water soluble or plastic can only be inserted into the paper web in the form of a thread and that too in the machine direction only. It is not possible to insert these threads with different patterns and shapes into the paper web. E.g. a paper currency cannot be seen with round shaped thread inserted into it. Also, these products
25 can be counterfeited easily due to lack of higher degree of security.

Also, security elements such as UV fibres, tracers, taggants and the like are randomly mixed in pulp and paper is formed. As much of the paper making process at the initial stage is maximum water, which is drained and recycled, these elements are lost or

conglomerated at a non-discreet area, which results in monetary losses. These security/elements are very expensive.

It has been the endeavor of all security paper mills to control costs, and so if these security features can be precisely guided into a known location, example by using the
5 printed text of the security thread, then there can be a lot of cost saving.

Further, embedding of security thread at a precise place slows down the paper machine thus giving lesser yield of paper. Wider width security thread has it's own problem as the pulp fibres have to flow onto a wider area thus slowing down the machine further.
10 Embedding of security thread also creates uneven bumps at certain places which necessitates the web to be moved sideways to spread the tension values throughout the cross direction of the web. This curtails higher lengths of paper to be wound on a single roll, which results in lesser yields due to various roll changes. This needs higher margin of variance for registration of the said thread in the paper web.

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Hence, to be ahead of the fraudsters there is a need to develop new and complex products and hence enhance the degree of security so that the product will not be simulated easily and at the same time such security thread with high degree of security is inserted into the paper web using existing paper making process so as not to incur costs of new machinery
20 and equipments.

Hence, the main objective of the present invention is to provide multiple security features on individual indicia or graphics in the security film.

25 Another objective of the present invention is to eliminate the process of demetallization and thus avoid the use of corrosive solvents.

Yet another objective of the present invention is to provide a security film having indicia printed in a particular pattern and shape and inserting the said security film into the paper

during the paper making process so as to restrict the counterfeiters from simulating the product.

Summary of Invention:

5 According to one aspect of the invention, there is provided a method of producing high security film for incorporating into a security paper such as currency note paper or the like comprising of the following steps:

- 10 i. loading a donor web roll on an unwinder of a multipass printing machines, unwinding and passing the donor web through a set of guide and tension control rolls into printing zone;
- ii. printing the desired indicia on the said donor web by passing it through one or more print station/s containing solution of adhesive and one or more security element/s;
- 15 iii. drying the donor web with adhesive printed indicia containing security elements by passing through one or more set of driers for evaporating the solvent contained in the adhesive leaving desired selective indicia pattern;
- iv. laminating the donor web containing aid adhesive printed selective indicia pattern along with one or more security element, with a receiver web by passing the said donor web and receiver web through nip/press rolls;
- 20 v. immediately splitting/separating out the said donor web and receiver web, on two different shafts obtaining the receiver web containing clearly transferred one or more security elements in very complex array of texts, images or graphics forming security film.
- 25 vi. optionally, rewinding the said laminate from step (iv) on a rewinder; ageing the said laminate, by stacking the roll on a stacker, for the desired ageing period and then splitting/separating out the said donor web and receiver web, on two different shafts obtaining the receiver web containing clearly transferred one or more security elements in very complex array of texts, images or graphics forming security film.

30 The said donor web is a like a hot stamping foil or a holographic foil or a non metallic stamping foil.

The said donor web consists of a first layer of plastic film such as a polyester film or a polypropylene film, a second layer of release coat, a third layer of dye coat to give various colours or effects and a fourth layer of metallic coat.

The said donor web also includes other layers such as a tie coats, protective coats, coatings for various effects, adhesive coats and the like.

According to one of the embodiment of the invention, one or more security elements are added in the said die coat layer and/or the said tie coat layer and/or adhesive layer and/or any other layers of the donor web.

10 According to another embodiment of the invention, the printing of the desired indicia on the donor web is carried out at the print station by using gravure cylinder or a flexo etched plate or by a web screen system.

According to another embodiment of the invention, the printing process of donor web with adhesive containing security elements is repeated any number of times in a number of print stations and the security element in the adhesive at each print station can be the same or different depending upon the degree of security required for the security paper.

20 The said indicia being printed includes any type of texts, graphics or images or a combination thereof printed on the donor web in desired pattern in straight line or curve or circle or any other shapes.

The said indicia printed on the donor web can be visible or invisible and optionally machine readable using external readers like specific electronic readers, light sources, PCRs or computers.

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The said adhesive solution being used for printing as per the process, is selected from the ones based on solvent such as hydrocarbons, xylenes, Toluols, organic solvents, ketonic solvents, alcohols or their derivatives or any combination thereof and are either one component or multi component or based on external catalyst.

The said adhesive solution used for printing, contains any one or combination of resins like acrylics, polyurathane, Polyvinyl Acetate (PVAC), epoxy, tackifying agents and the like.

- 5 The said adhesive solution used for printing can also be a water based consisting of a mixture of water, gluing ingredients such as glue, CMC, starch solution.

The said security elements contained in the adhesive solution used for printing or added in the die coat layer/tie coat layer/hear activated and pressure activated layer or any other
10 layer of the donor web, are selected from overt or covert security element such as rare earth pigments, light fluorescing pigments, machine readable materials, DNA taggants, magnetic particles, UV upconversion pigments, security microtracers, nanoparticles, micro wires and the like. However, these are by no means limiting.

The said security elements are either visible, invisible or machine readable using external
15 readers like specific electronic readers, light sources, PCR's, or Computers.

According to yet another embodiment of the invention, the said receiver web is a water soluble film (WSF) produced by any of the process such as by direct casting on a conveyor, by casting on a detachable liner, a T-die casting, by blowing film on extrusion
20 machine by extrusion via T-die extrusion or direct of WSF film forming resins.

The said WSF is either cold water soluble or warm water soluble or hot water soluble or non soluble hydrophilic biodegradable film, the water temperature depending upon the formulations and resins of the said WSF and ranges in between 5⁰c to 100⁰c.

25 According to yet another embodiment of the invention, the said receiver web is a plastic film.

According to yet another embodiment of the invention, the temperatures at the set of driers used for evaporating the solvent ranges from 30⁰C to 190⁰C, preferably from 45⁰C
30 to 150⁰C, more preferably from 60⁰C to 120⁰C.

According to yet another embodiment of the invention, the pressure at the nip/press rolls, applied for laminating the two webs ranges from 0.5 psi to 10 psi, preferably from 1 psi to 6 psi, more preferably from 2 psi to 4 psi.

- 5 According to yet another embodiment of the invention, the said ageing period ranges from 2 minutes to 72 hours, preferably from 5 minutes to 36 hours and more preferably from 10 minutes to 24 hours.

10 According to yet another embodiment of the invention, the high security film for incorporating into a security paper such as currency notes comprises printing selective indicia with the help of adhesive containing one or more security elements on the receiver web followed by drying and then laminating the donor web to transfer the metallic surface of the donor web on the receiver web the said receiver web being the plastic film or water soluble film (WSF) and the said donor web being the hot stamping foil or the
15 holographic foil.

According to yet another embodiment of the invention, the desired indicia is reverse printed as per the requirement.

- 20 According to a second aspect, the invention provides a high security film having precisely registered and cleanly transferred indicia pattern/s such as texts, graphics and/or images comprising one or more security elements in one or more texts or nanopart of an image or graphics.

- 25 According to a third aspect, the invention provides a method of incorporating the high security film in the high security paper like currency notes, which the said high security film/roll is silt into micro tapes also known as the security thread and inserted into the paper web during the paper making process.

According to a fourth aspect, the invention provides a method in which the whole web of the said high security film is inserted into the paper web during the paper making process so that the indicia including letters, images and/or graphics printed in a particular pattern is incorporated into the paper at precise location.

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As per yet another embodiment of the invention, the whole web of the said high security film is perforated at selective places for subsequent insertion into paper web during the paper making process.

10 **The invention will now be described with reference to accompanying drawings wherein:**

FIG. 1, shows in schematic diagram the method of producing high security film, according to an embodiment of this invention.

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FIG. 1A, shows in schematic view, the donor film, showing its various layers, for making high security film, according to an embodiment of this invention.

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FIG. 2 and 2A, shows in perspective view, the high security film web with printed indicia in a different pattern and a currency note incorporated with the said high security film.

FIGS. 3, shows in perspective view, the high security thread with printed indicia having different security elements, in various patterns.

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Referring to FIG. 1, the method of producing high security films, according to an embodiment of this invention comprises the following steps:

- i. Unwinding a roll of donor web (1) from unwinder (2), of a multiple pass print-coating machine.
- ii. Passing it through a set of guide and tension control rolls and zone printing the
30 desired indicia by passing the said donor web through web print coat station (3)

containing a solution of adhesive and one or more security elements. A flexo etched plate or a gravure cylinder or any other printing process can also be used in place of web screen system.

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- iii. The said donor web with adhesive printed indicia consisting security elements, is passed through a pre-designed set of driers (4) and the solvents contained in the adhesive evaporates leaving behind a selective indicia pattern. The temperature in the dryers ranges from 30⁰C to 190⁰C, preferably from 45⁰C to 150⁰C, more preferably from 60⁰C to 120⁰C. The said adhesive printed selective indicia pattern containing text letters or graphics or images, and security elements, will have a green tack value, which is enough to transfer itself when it comes in contact with the incoming receiving web.
 - iv. The said donor web with adhesive printed indicia consisting security elements, is then passed through another gravure print station (5), containing a solution of adhesive and one or more security elements. The security elements in the adhesive are either same or different from the previously used security elements, depending upon the degree of security required for the security paper. The same process can be repeated for any number of times to produce a security film having multiple security features.
 - v. The said donor web (10) produced as per the above steps, containing the said adhesive printed selective indicia pattern along with one or more security elements is then is then brought together with the incoming receiving web (11). The said webs brought together are laminated by applying pressure at the nip rolls/press rolls (13). The pressure applied at the nip/press rolls ranging from 0.5 psi to 10 psi, preferably from 1 psi to 6 psi, more preferably from 2 psi to 4 psi.
 - vi. The said laminate is then immediately split/separated out and the said donor web and receiver web are rewound on two different shafts obtaining the receiver web containing clearly transferred one or more security elements in very complex array of texts, images or graphics forming security film.
 - vii. Preferably, the said laminate (14) from step (v) is rewound on a rewinder (15) and is kept for a specified period of ageing which ranges between 2 minutes to 72 hours,

preferably 5 minutes to 36 hours and more preferably 10 minutes to 24 hours and then the two webs are separated.

5 The said donor web (1) such as a hot stamping foil consists of various layers such a plastic film coated with at least a release lacquer and subsequent performance oriented lacquers like but not limited to a dye coat for specific effect, a tie coat to tie the dye coat and vacuum deposited metal, a metallic coat, which includes metallic flakes, vacuum metal deposition, fine oxide deposition, etc.

10 The said donor web (1) such as holographic foil having holographic images includes all types of holograms made from various types of shims, using diverse technologies like, but not limited to, dot matrix, electron beam., laser, 2 Dimensional, 3 Dimensional, etc. whether machine readable or not, whether in roll, tape or sheet forms or any shapes. Certain holographic images made by patented processes have been registered trademarks, like Moviegrams, Kinegrams etc. These shall also be included as holographic images for
15 the purpose of this invention.

The said dye coat of the said donor web may be replaced with a colour shift lacquer to give a different effect or the said hot stamping foil or the holographic foil may have a clear dye coat to give a silver metallic look.

20 Further, this invention provides a donor film wherein one or more security elements are incorporated into one or more layers of the said donor film itself. The said donor film consisting security elements is then used as a donor web for the print transfer process as described in figure 1.

The said donor film with security elements is produced as follows:

25 Unwinding of a carrier web i.e. a plastic film such as a such as a polyester film or a polypropylene film and the like, having thickness ranging from 3 microns to 50 microns. Coating the said carrier web with a release coat such as a silicone coating, wax coating and the like. The thickness of the said release coat ranges from 0.01 to 5 microns. Drying the said release coat by passing it through a set of dryers, the temperature in the dryers
30 ranging from 30⁰C to 150⁰C, preferably from 40⁰C to 100⁰C, more preferably from 50⁰C

to 90⁰C. Mixing a dye coat with one or more security elements and coating the same on the release coated side of the plastic film. The said dye coat is formed by mixing of film forming binders such as nitrocellular lacquers, acrylic resins, transparent dyes and the like, as is well known in the art. The thickness of the said dye coat ranges from 0.01 to 5
5 microns. Drying the said dye coat by passing it through a set of dryers, the temperature in the dryers ranging from 40⁰C to 190⁰C, preferably from 60⁰C to 170⁰C, more preferably from 70⁰C to 150⁰C. Applying a tie coat mixed with one or more security elements over the said dye coat. The said tie coat is formed by mixing of film forming binders, high strength resins selected from polyurethanes, acrylics, polyesters and the like, as is well
10 known in the art. The thickness of the said tie coat ranges from 0.01 to 5 microns. Drying the said tie coat by passing it through a set of dryers, the temperature in the dryers ranging from 40⁰C to 190⁰C, preferably from 60⁰C to 170⁰C, more preferably from 70⁰C to 150⁰C. The above mentioned coats are applied using coating processes such as gravure, flexo plate, air knife, mayer bar and the like. Vacuum deposition of metals such
15 as aluminium, zinc and the like over the said tie coat as per the process well known in the field. The thickness of the said vacuum deposited aluminium layer ranging from 1 micron to 5 microns. Optionally applying an adhesive coat mixed with one or more security elements, over the vacuum deposited aluminium layer. The said adhesive performs when heat and pressure is applied and is formed by mixing low melting resins with high
20 adhesion bond value, high tack adhesives, acrylic adhesives, tackifiers and the like, as is well known in the art. The thickness of the said adhesive layer ranges from 1 micron to 9 microns. Drying the said adhesive layer by passing it through a set of dryers, the temperature in the dryers ranging from 40⁰C to 190⁰C, preferably from 60⁰C to 170⁰C, more preferably from 70⁰C to 150⁰C.

25 Other coatings such as abrasion resistant coats or any other coats giving different effects can also be applied during the formation of the said donor film.

One such donor film so formed is shown in figure 1A wherein, (16) shows a layer of carrier web, (17) is the release coat, (18) shows a dye coat incorporated with one or more security elements, (19) is a layer of tie coat i.e. a lacquer incorporated with one or more
30 security elements, (20) comprises a metallic layer and (21) shows the layer of a heat

activated and pressure activated adhesive incorporated with one or more security elements..

Further, one or more security elements can be incorporated into one or more different layers of the said donor film.

5 Thus, the said donor film consisting security elements, produced as per the above process, is then used as a donor web for producing a high security film as per this invention. This will provide multiple security features in the security paper and thus enhance the security.

10 The said indicia include any type of a text, graphics or image which is printed on any of the webs as per pre-specified design. This can be visible or invisible and may be machine-readable using external readers like specific electronic readers, light sources, PCRs or computers.

15 The said adhesive is selected from the ones based of solvent such as hydrocarbons, Xylenes, Toluols, organic solvents, ketonic solvents, alcohols or their derivatives or any combinations there of. These solvents may also be water based in certain cases. The adhesive lacquer may contain one or a combination of resins like acrylics, polyurethane, PVAC (Polyvinyl acetate), epoxy, tackifying agents and the like. These adhesives may be
20 one component or multi component i.e. may be based on external catalyst or direct. However, these adhesives are by no means limiting.

Optionally, the said adhesive is water based consisting of a mixture of water, gluing ingredients, such as glue/CMC/starch solution, thereby partially spot wetting the water soluble film and enabling the adhesion to the preformed WSF, optionally using pressure
25 rollers and then rewinding this ensuing carrier on an external rewinder with two distinct webs. The temperature of the water at the print station or stations in case of multiple and distinct security features are used but before the webs are laminated, shall range between 10°C to 95°C , preferably between 20°C to 80°C , more preferably between 30°C to 75°C .

The said security elements contained in the adhesive or different layers of the donor film are selected from overt or covert security elements such as rare earth pigments, light fluorescing pigments, machine readable materials, DNA taggants, magnetic particles, UV upconversion pigments, security dyes, micro tracers, nano particles and the like and are either visible, invisible or machine readable using external readers like specific electronic readers, light sources, PCRs or computers.

Optionally, reverse printing of the desired indicia can also be done in the same manner as per the requirement.

10 The said receiver web is a water soluble film (WSF). Optionally, a plastic film can also be used as a receiver web.

The said WSF can be manufactured by process of direct casting on a conveyor, by casting on a detachable liner, by casting from a T-die casting, by blowing film on extrusion machines, or by extrusion via T-die extrusion. The formulation of said WSF shall determine the temperature of water in which the said WSF shall easily dissolve. This range of water temperature shall vary, but not limited to, between 5⁰C to 100⁰C. For the purpose of this invention it is clarified that WSF encompass all types of WSF made from any of the above methods, including direct coating of WSF film forming resins.

20 The water soluble film mentioned here may be either cold water soluble or warm water soluble or hot water soluble depending upon the formulation and resins or their combination used. E.g. higher the mole value of the resin, lower the solubility of the film and lower the mole value of the resin, higher the solubility.

CWSF: cold water soluble film shall mean a water soluble film which dissolves in water having temperature ranging from 1⁰C to 35⁰C, preferably from 6⁰C to 30⁰C, more preferably from 10⁰C to 25⁰C.

WWSF: warm water soluble film shall mean a water soluble film which dissolves in water having temperature ranging from 30⁰C to 55⁰C, preferably from 35⁰C to 50⁰C.

HWSF: hot water soluble film shall mean a water soluble film which dissolves in water having temperature ranging from 55⁰C to 95⁰C, preferably from 60⁰C to 85⁰C, more preferably from 65⁰C to 75⁰C.

5 NSHF: non soluble hydrophilic film shall mean a film which does not dissolve in water but is of hydrophilic nature i.e. has affinity towards moisture or water or water based liquids and this film is also completely biodegradable. This type of film will swell on application of moisture but will not dissolve in totality.

10 The raw materials used for manufacturing water soluble films are selected from polyethylene glycol, glycerin, propylene glycol, polyvinylpyrrolidone, proteinaceous binders such as gelatin, modified gelatins such as phthaloyl gelatin, sodium alginate, polysaccharides such as starch, gum Arabic, pullulan and dextrin, tragacanth gum, guar gum, acacia gum, polyacrylic acid, methylmethacrylate copolymer, carboxyvinyl
15 polymer, amylose, sweeteners, pectin, chitin, chitosan, levan, elsinan, collagen, zein, gluten, soy protein isolate, casein, shallac and water-soluble cellulose derivatives or combination thereof. The cellulose derivatives used are methyl cellulose, hydroxy propyl cellulose, hydroxy propyl methyl cellulose, hydroxy propyl ethyl cellulose, hydroxy ethyl cellulose, carboxy methyl cellulose, Polyvinyl alcohol copolymer ionomers, Polyvinyl
20 alcohol homopolymer, non – ionomeric poly vinyl alcohol polymer, Polymethacrylate., polyvinyl alcohol, polyacrylamide, polymethacrylamide, polyacrylic acid, polymethacrylic acid, polyurethane. However, these raw materials are by no means limiting

25 Further, after the separation of the two webs on two different shafts, the donor roll may be used to donate another set of an indicia pattern by shifting the registration during the print process. Hence, this will result in lot of saving to reduce the costs of end product.

30 As per one of the embodiments of the invention, the above process can also be carried out by printing selective indicia with the help of adhesive containing one or more security

elements, on the receiver web, drying and then laminating a donor web, so as to transfer the metallic surface of the donor web on the receiver web.

5 The resultant product being a high security film, will have very complex array of texts, graphics and images which are precisely registered and cleanly transferred onto a receiver film based web having one or more security elements in one or more text or a nano part of an image or graphic which can be identified with a specified light source like, but not limited to, an Ultraviolet light of varying nanometers or an infra red light or an electronic reader reading peaks and valley values of a rare earth pigment or a dye or a specified
10 magnetic field.

This high security film roll may optionally be slit into micro tapes, also known as security thread and is then inserted into the paper during the paper making process as per the methods well known in the prior arts.

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As per one of the embodiments of the invention, the whole web of the security film is inserted into the paper web during the paper making process, so that the indicia including letters and graphics printed in a particular pattern and shape can also be incorporated into the paper at precise location. The whole web of the film can be inserted at the couch roll
20 or at the vacuum chamber or at the press rolls of the cylinder mould machine; or at the dandy roll of a fourdriner machine or between two paper beds.

Figure 2 shows a web of the receiver film (22) transfer printed with indicia (23) in a circle form. The web (22) is cut into a smaller web from (24). The said smaller web is then inserted into the paper during the paper making process, at precise location, to
25 produce a security paper such as a banknote paper (25) as shown in figure 2A.

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Example1:

We unwound a metallic donor web having thickness 12 microns, at the unwinder. We printed the indicia letter 'I' by gravure printing method, using an ethyl acetate based adhesive CAC 1511 and hardener as available from Converter Adhesive and Chemical Ltd. and passed it through dryers for evaporating the solvent of the adhesive as per the process shown in figure 1. The said ethyl acetate based adhesive (1 litre) is mixed with 100 grams of UV fluorescent pigment invisible to red prior to printing. After drying the said adhesive printed indicia letter 'I', the said metallic donor web is then transferred through a second gravure printing head wherein, indicia letter 'N' is printed using the same adhesive as used earlier but different security element. The said ethyl acetate based adhesive (1 litre) is mixed with 100 grams of UV fluorescent pigment invisible to yellow. In the same manner other indicia letters such as D, I and A are printed by through consecutive gravure printing heads. Indicia letter 'D' will consist UV fluorescent pigment invisible to green, indicia letter 'I' will consist UV fluorescent pigment invisible to yellow, indicia letter 'A' will consist UV fluorescent pigment invisible to red. We then laminated the said metallic donor web with adhesive printed indicia to a preformed hot water soluble, having thickness 20 microns, as is available from Arrow Coated Products Ltd. The laminated web was kept an ageing period of 72 hours. Then we separated the two webs. The adhesive printed indicia were by this time transferred on the hot water soluble film. The said hot water soluble film was then slit into micro tapes to get a high security thread as shown in the figure 3, which can be then inserted into the paper during the paper making process.

Figure 3, shows a high security thread (26) wherein indicia letter 'I' (27) consists of UV fluorescent pigment invisible to red, indicia letter 'N' (28) consists of UV fluorescent pigment invisible to yellow, indicia letter 'D' (29) consists of UV fluorescent pigment invisible to green, indicia letter 'I' (30) consists of UV fluorescent pigment invisible to yellow and indicia letter 'A' (31) consists of UV fluorescent pigment invisible to red.

Hence, when the above high security thread is observed under a UV transmitted light, the indicia letter 'I' (27) will appear red, the indicia letter 'N' (28) will appear yellow, the

indicia letter 'D' (29) will appear green and so on. Hence, it will be very difficult for counterfeiters to provide a security paper with such as high security thread.

Example 2:

5 We unwound a roll of a carrier film i.e. a plastic film having thickness of 10 microns and we coated it with a hot wax based release coat having thickness 0.5 microns. A layer of a dye coat i.e. vinyl based resin solution, having thickness of 1 micron was then applied on the release coated side of the plastic film. The said resin solution used as a dye coat, consisted invisible UV fluorescing red pigment, as available from Honeywell, Germany.
10 25 ml of the said 1000 ml of the said resin solution.

A tie coat i.e. acrylic based resin solution, having thickness 1 microns was then applied above the said dye coat. The said tie coat consisted of DNA taggants, as available from Tracetag, U.K. 10 gms of the said DNA taggants were mixed with 1000 ml of the said resin solution.

15 The tie coat side of the said plastic film was then metallised in a vacuum chamber, using aluminium. The thickness was about 2 micron.

The said donor film consisting security elements, was then used as a donor web for producing a high security film as per the process described in this invention.

The high security film so formed as per the invention, using the above mentioned donor
20 film consisting security elements was then slit into micro tapes/thread and then inserted into the paper web as per the process well known in the art. The said paper consisting of the said security thread was then subjected to testing and DNA taggant was observed to be present. Also the printed indicia appeared red under the UV transmitted light because of the invisible UV fluorescing red pigment being present in the dye coat.

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WE CLAIM :

1. A method of producing high security film for incorporating into a security paper such as currency note paper or the like comprises of the following steps:
 - 5 i. loading a donor web roll on an unwinder of a multipass print-coat machine, unwinding and passing the donor web through a set of guide and tension control rolls into printing zone;
 - ii. printing the desired indicia on the said donor web by passing it through one or more print station/s containing solution of adhesive and one or more security element/s;
 - 10 iii. drying the donor web with adhesive printed indicia containing security elements by passing through one or more set of driers for evaporating the solvent contained in the adhesive, leaving desired selective indicia pattern;
 - iv. laminating the donor web containing said adhesive printed selective indicia pattern along with one or more security element, with a receiver web by passing
15 the said donor web and receiver web through nip/press rolls;
 - v. immediately splitting/separating out the said donor web and receiver web, on two different shafts obtaining the receiver web containing clearly transferred one or more security elements in very complex array of texts, images or graphics forming security film.
 - 20 vi. optionally, rewinding the said laminate from step (iv) on a rewinder; ageing the said laminate, by stacking the roll on a stacker, for the desired ageing period and then splitting/separating out the said donor web and receiver web, on two different shafts obtaining the receiver web containing clearly transferred one or more security elements in very complex array of texts, images or graphics
25 forming security film.
2. The method according to claim 1, in which the said donor web is a hot stamping foil or a holographic foil or a non metallic stamping foil.
3. The method according to claims 1 or 2, in which the said donor donor web, consists of a first layer of plastic film such as a polyester film or a polypropylene film, a

second layer of release coat, a third layer of dye coat to give various colours or effects and a fourth layer of metallic coat.

4. The method according to claim 3, in which the said donor web also includes other layers such as a tie coats, protective coats, coatings for various effects, adhesive coats and the like.
5. The method according to claims 3 or 4, in which one or more security elements are added in the said die coat layer and/or the said tie coat layer and/or adhesive layer and/or any other layers of the said donor web.
6. The method according to claim 1, in which the printing of the desired indicia on the donor web is carried out at the print station by using gravure cylinder or a flexo etched plate or a web screen system.
7. The method according to claim 1, in which the printing process of donor web with adhesive containing security elements is repeated any number of times in a number of print-coating stations and the security element in the adhesive at each print station can be the same or different depending upon the degree of security required for the security paper.
8. The method according to claim 1, in which the said indicia includes any type of texts, graphics or images or a combination thereof printed on the donor web in desired pattern in straight line or curve or circle or any other shapes.
9. The method according to claim 8, in which the said indicia printed on the donor web is visible or invisible and maybe machine readable using external readers like specific electronic readers, light sources, PCRs or computers.
10. The method according to claim 1, in which the said adhesive in the solution used for printing is selected from the ones based on solvent such as hydrocarbons, xylenes, Toluols, organic solvents, ketonic solvents, alcohols or their derivatives or any combination thereof and are either one component or multi component or based on external catalyst.
11. The method according to claim 1, in which the said adhesive solution used for printing, contains any one or combination of resins like acrylics, polyurathane, Polyvinyl Acetate (PVAC), epoxy, tackifying agents and the like.

12. The method according to claim 1, in which the said adhesive used for printing is water based consisting of a mixture of water, gluing ingredients such as glue, CMC, starch solution.
13. The method according to claim 1, in which the said security elements contained in the adhesive solution used for printing or added in the die coat layer/tie coat layer/heat activated and pressure activated layer or any other layer of the donor web are selected from overt or covert security element such as rare earth pigments, light fluorescing pigments, machine readable materials, DNA taggants, magnetic particles, UV upconversion pigments, security microtracers, nanoparticles, micro wires and the like.
14. The method according to claim 1 or 13, in which the said security elements are either visible, invisible or machine readable using external readers like specific electronic readers, light sources, PCRs, or Computers.
15. The method according to claim 1, in which the said receiver web is a water soluble film (WSF) produced by any of the process such as by direct casting on a conveyor, by casting on a detachable liner, a T-die casting, by blowing film on extrusion machine by extrusion via T-die extrusion or direct of WSF film forming resins.
16. The method according to claim 15, in which the said WSF is either cold water soluble or warm water soluble or hot water soluble or non soluble hydrophilic film, the water temperature depending upon the formulations and resins of the said WSF and ranges in between 5⁰c to 100⁰c.
17. The method according to claim 1, in which the said receiver web is a plastic film such as a polyester film or a polypropylene film.
18. The method according to claim 1, in which the temperatures at the set of driers used for evaporating the solvent ranges from 30⁰C to 190⁰C, preferably from 45⁰C to 150⁰C, more preferably from 60⁰C to 120⁰C.
19. The method according to claim 1, in which the pressure at the nip/press rolls, applied for laminating the two webs ranges from 0.5 psi to 10 psi, preferably from 1 psi to 6 psi, more preferably from 2 psi to 4 psi.

20. The method according to claim 1, in which the said ageing period ranges from 2 minutes to 72 hours, preferably from 5 minutes to 36 hours and more preferably from 10 minutes to 24 hours.
21. A method of producing high security film for incorporating into a security paper such as currency notes comprising printing selective indicia with the help of adhesive containing one or more security elements on the receiver web followed by drying and then laminating the donor web to transfer the printed indicia from the donor web on the receiver web.
22. A method according to claim 1 or 21, in which reverse printing of the desired indicia is carried out as per requirement.
23. A high security film produced by the method according to any of the preceding claims having precisely registered and cleanly transferred indicia pattern/s such as texts, graphics and/or images comprising one or more security elements in one or more texts or nanopart of an image or graphics.
24. A method of incorporating the high security film, according to claim 23 in the high security paper like currency notes, which the said high security film/roll is silt into micro tapes also known as the security thread and inserted into the paper web during the paper making process.
25. The method according to claim 24, in which the whole web of the said high security film is inserted into the paper web during the paper making process so that the indicia including letters, images and/or graphics printed in a particular pattern is incorporated into the paper at precise location.
26. The method according to claim 25, in which the whole web of the said high security film is perforated at selective places for subsequent insertion into paper web during the paper making process.
27. A method of producing high security film for incorporation into a security paper such as currency note paper or the like substantially as herein described and illustrated in FIGS. 1 to 3 of the accompanied drawings.

28. A high security film for incorporating into a security paper such as currency notes paper or the like substantially as herein described and illustrated in FIGS. 2 & 2A of the accompanying drawings.

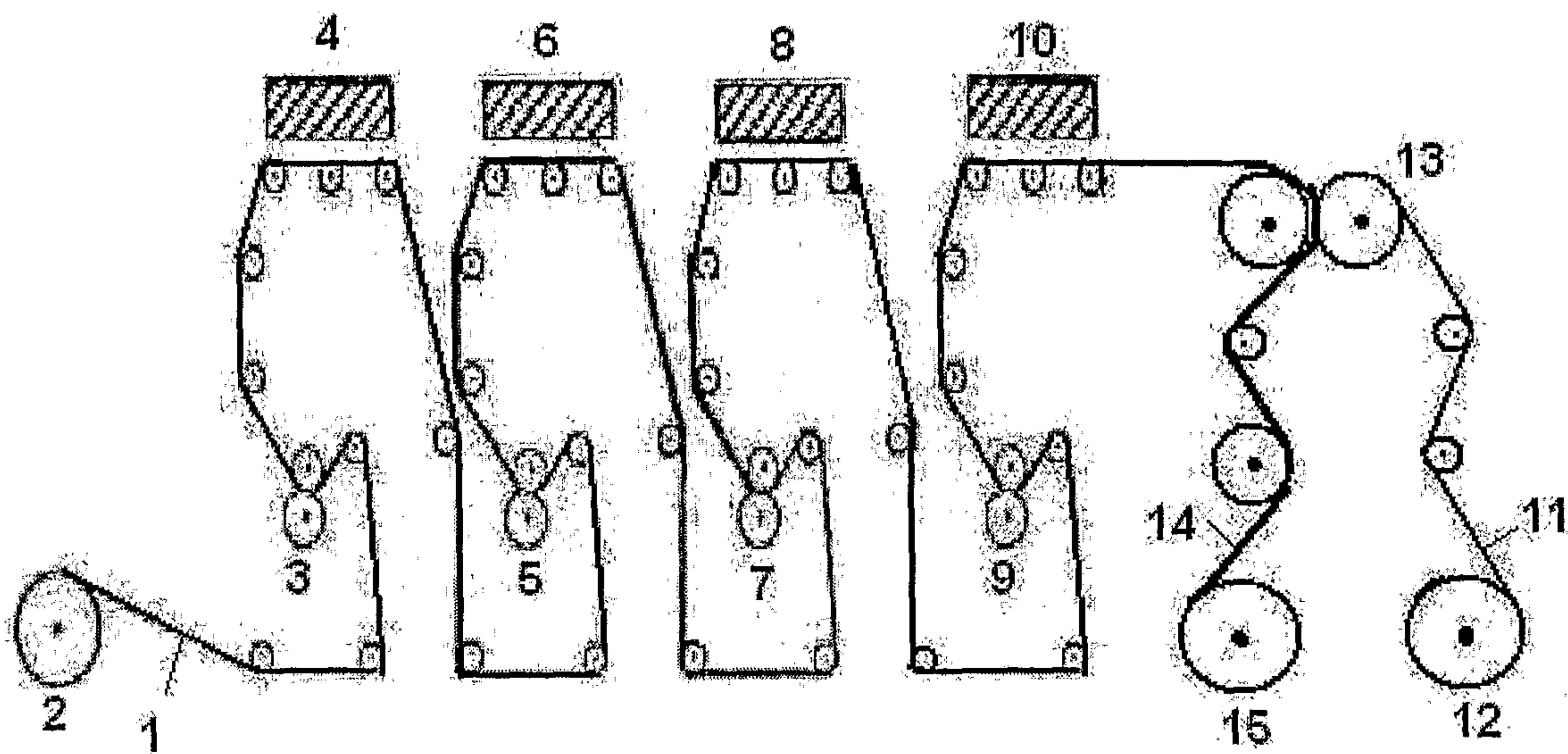


FIGURE 1

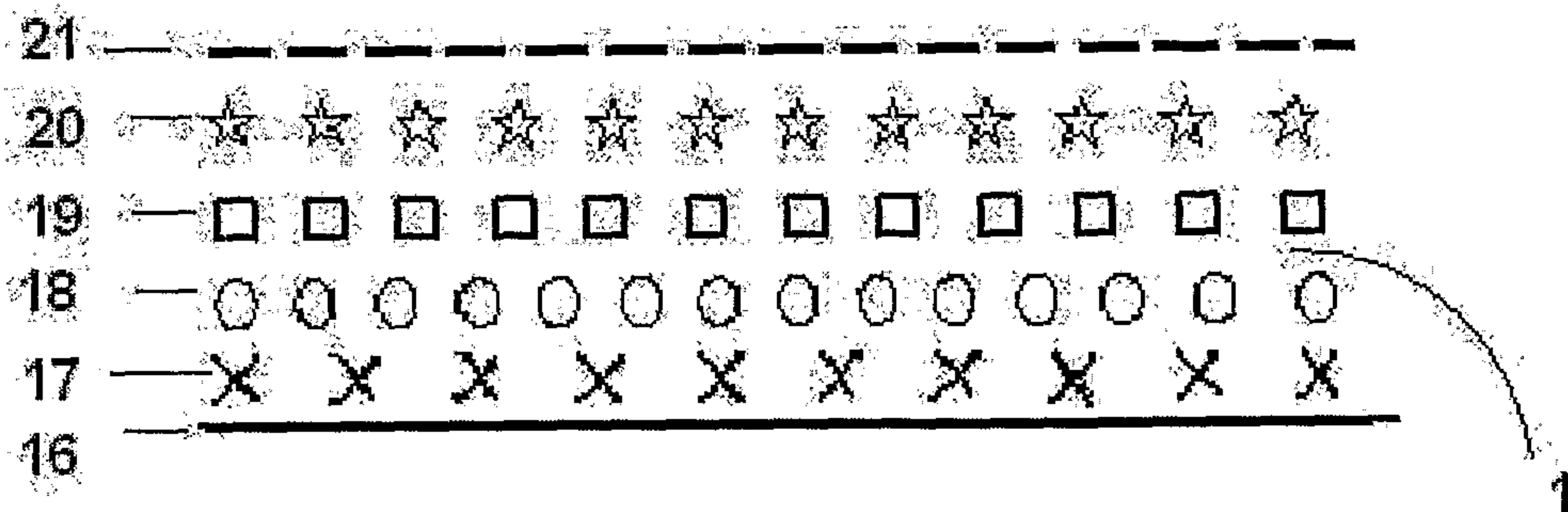


FIGURE 1A

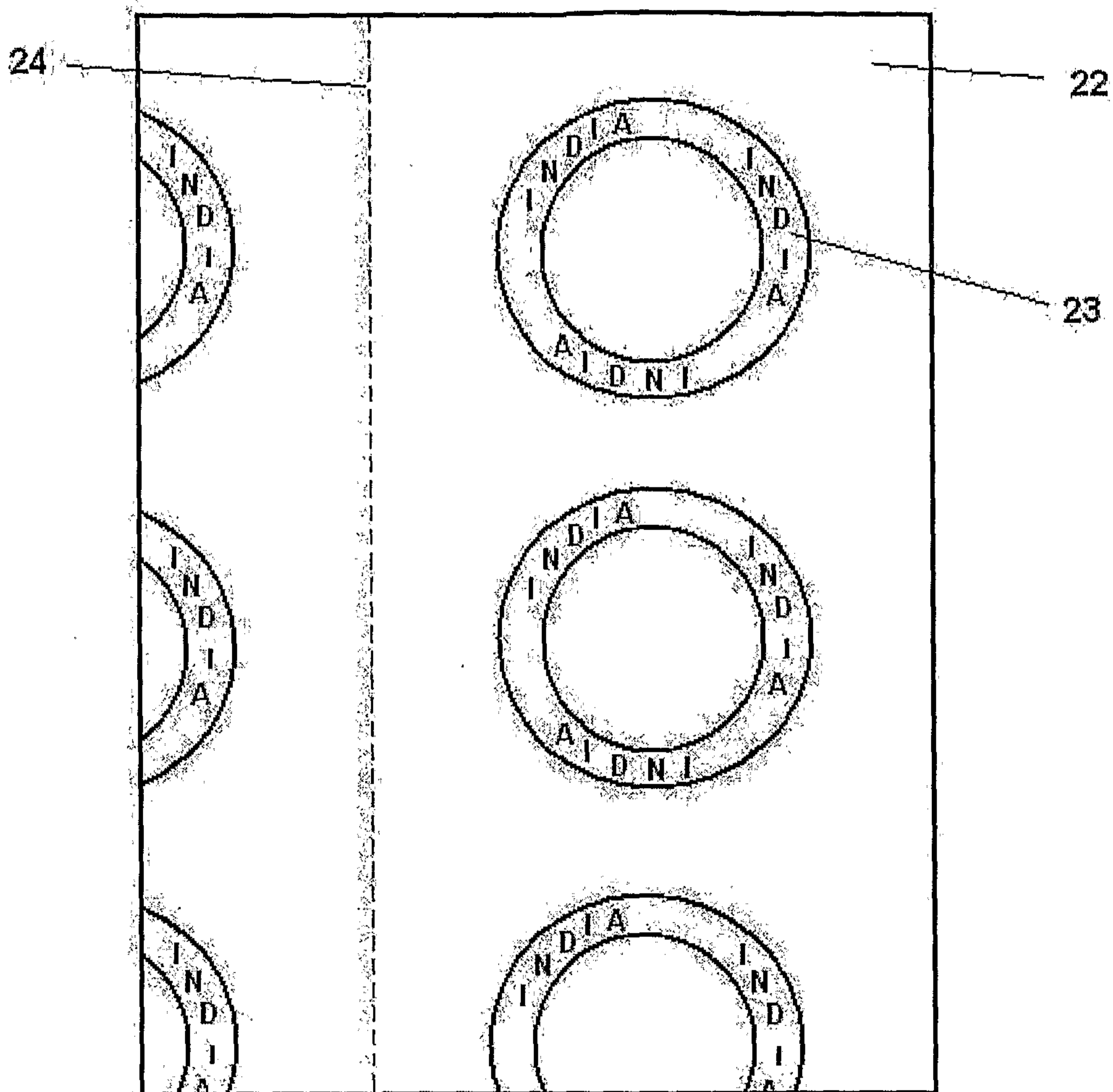


FIGURE 2

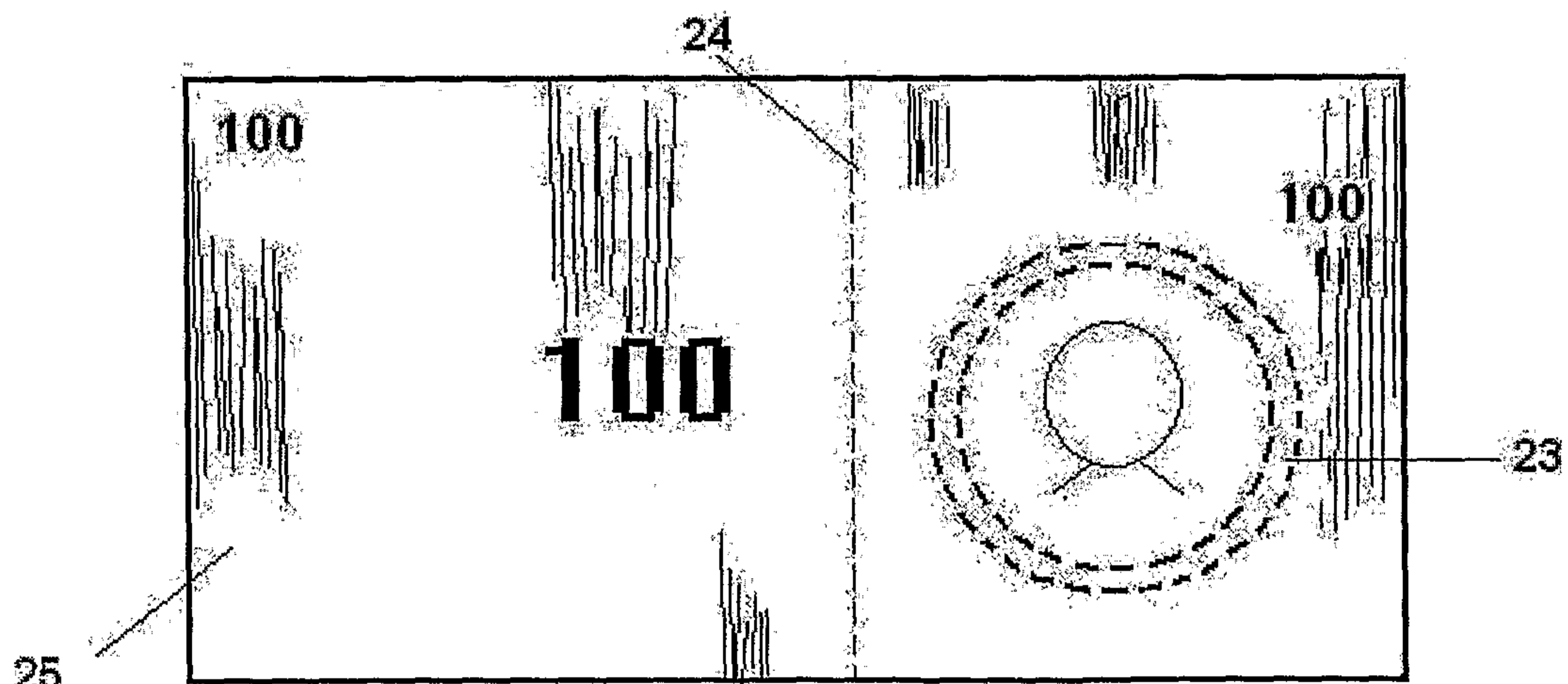


FIGURE 2A

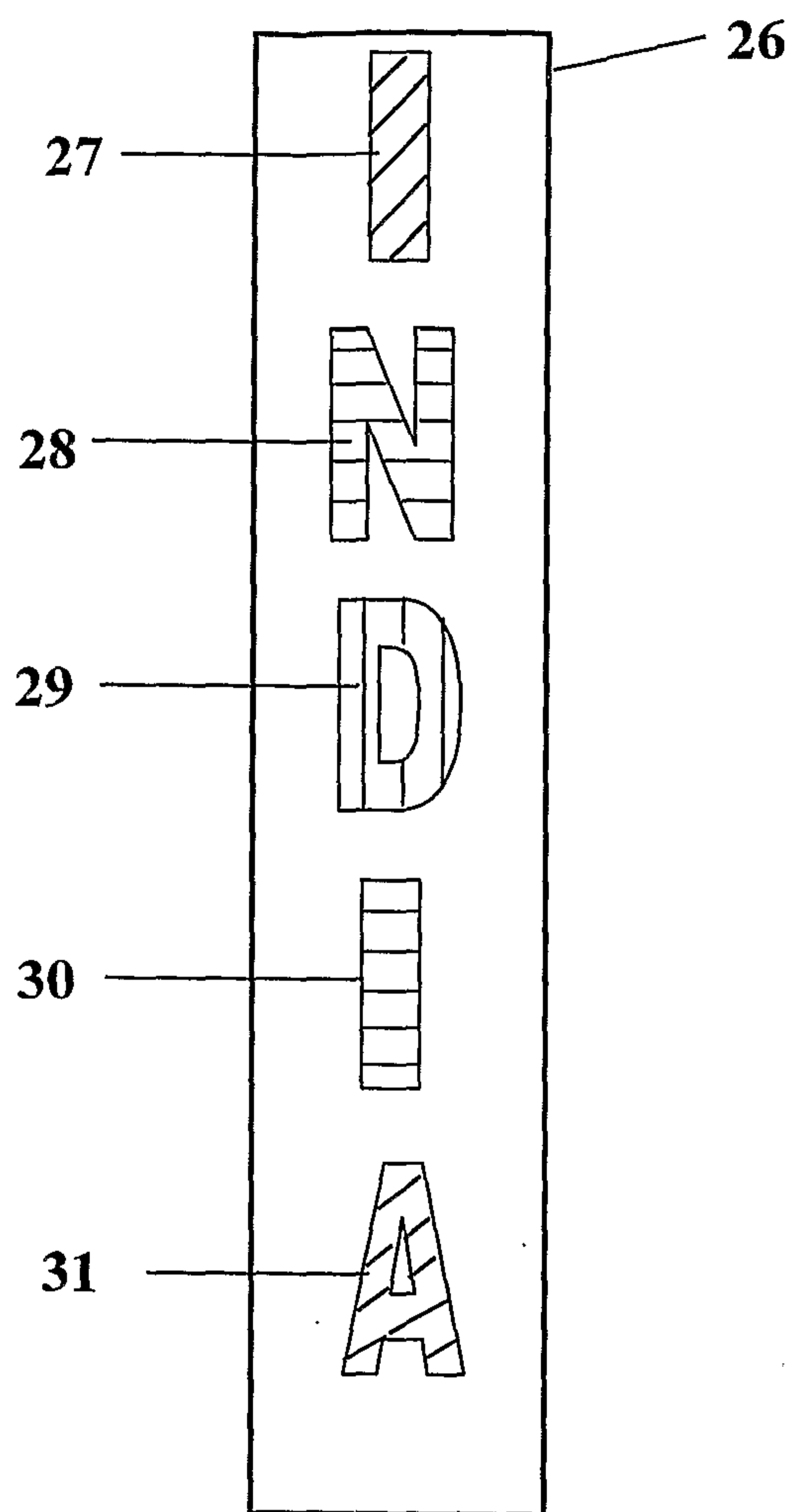


FIGURE 3