ABSTRACT

A pressure sensitive removable adhesive is applied on ribbons used for wrapping the counted bundles of currency notes. The wrapping is in a way that a portion on the sides of the stack of notes will face enough amount of adhesive, to adhere each leaf of the note with the ribbon strap, so that pulling out a note from a packed bundle will become difficult. Tissue tape will have tear lines made of perforation or cuts so that it will disintegrate if opened. The adhesive can have chemical and/or colour coding for further security.
Fig 3

310

320

330
Fig 4

A B C

100$ 410

A B C

420

A B C

100$ 430

A B C

440
PILFER AND TAMPER RESISTANT STRAPPING OF SHEET MATERIAL INCLUDING CURRENCY NOTES

FIELD OF THE INVENTION

[0001] The invention generally relates to packaging sheet material and specifically to packing currency notes in bundles e.g. 100s for facilitating banking and other transactions involving bulk cash.

[0002] More specifically the proposed invention is to make a better, economical removable and tamper-resistant packing of banknotes non-invasively, yet retaining the ability to count those manually or mechanically by flipping, with the least change in the existing methods.

BACKGROUND OF THE INVENTION

[0003] Currency notes such as pounds, dollar bills or rupees are traditionally packed in 100s with the help of staples and paper or plastic sheet ribbons around an axis.

[0004] Staples have become out of fashion because of invasiveness and difficulty in unpacking, including mutilation. Due to these disadvantages, now increasingly the currency note bundles are packed with just a ribbon strap wrapped loosely around one of the axis generally vertical axis, traverse to the printed surface, so that the notes could be still counted by flipping on a counting machine.

[0005] Depending only on ribbon strap around a pack of notes has led to a disadvantage because a note from a bundle can be easily removed now, without unpacking the bundle. This leads to further problems such as the need to count the notes in the bundle each time it changes hand, and the responsibility shifting immediately without recourse. Especially in transactions where bulk of cash handled e.g. in a treasury of a retail operation, it has means that the good faith that each bundle has 100 notes of a denomination is much lesser and the recourse in case of a bundle has lesser than 100 notes is also lesser because it is easy to remove one from a pack. For example, in a bank teller counter, the customer has to completely depend on the teller and her counting machine. Assuming an unavoidable error rate of counting machine, if the customer receives a note less in the pack, say 99 instead of 100, and she leaves the counter without manually counting the notes, which may be impractical in most situations, there is hardly any recourse. If the notes were pilfered-packed e.g. stapled, the burden of proof would shift on the institution that put the staple, to establish whether there was a counting error or a note has been pilfered subsequently. Other known alternative methods like shrink-wrap packing do not help because it goes to the other perceived extreme of complete dependence and accountability of the first packer, because these make subsequent counting without unpacking impossible.

[0006] In WO/2004/078485 SHEARLE has disclosed a clip for TAMPER EVIDENT DOCUMENT BUNDLE and has also cited some prior arts. The most important disadvantage in the SHEARLE is that it squarely depends on the compressive pressure applied by a Clip, which will be more difficult and costlier to apply and calibrate. There is a possibility of mutilating a sheet if the pressure is too much. Moreover, the pressure applied through the clip may not remain constant in time due to fatigue and due to elasticity and plasticity in the material used for making the clip, a careful and persistent tampering attempt to loosen the grip gradually, e.g. by minutely shifting a number of sheets together or by inserting a thin piece of metal dexterously between two portion in the stack, the bundle can be tampered with without leaving easily available evidence. Moreover, the Clip device is bulkier and will likely disturb the existing arrangement of further packaging and processing of multiple stacks, e.g. requiring more space.

[0007] In the present invention the problem is solved by simplified means of application of straps made of specialized glue tapes providing securing means and being quite different from the prior securing means of compressive clip and a tamper evident cover covering the clip, yet achieving better results of pilfer and tamper resistance, as explained hereunder.

BRIEF DESCRIPTION OF THE INVENTION

[0008] In one embodiment the present invention contemplates using an adhesive on a ribbon strap made of suitable sheet material, to be used for making the counted bundles of currency notes. Such ribbon strap tapes will have a rubber based or synthetic acrylic based removable adhesive, applied in a way that the portion of the tape falling on the two sides of the stack of notes will have an enough amount of adhesive, so that it will adhere each leave of the note with the side of the tape, so that pulling out a note from a packed bundle will be difficult without opening the ribbon. The ribbon strap with adhesive will also exert a compressive pressure on the sheets in the pack, making removal of a sheet without opening the pack more difficult.

[0009] Further, the strap will have partial cuts or perforations or weakened tear lines so that it will disintegrate if opened or if a sheet is pulled from the stack. In a preferred embodiment, the adhesive will also comprise a colour so that if an attempt to pull a sheet is successfully made, the coloured adhesive will leave a visible streak of smudge on the side of the pulled sheet and/or the remaining sheets in the bundle, making the tampering evident.

DESCRIPTION OF THE DRAWINGS

[0010] FIG. 1 shows a conventional configuration of ribbon strap wrapper on a stack of currency notes.

[0011] FIG. 2 shows an invented configuration in an embodiment.

[0012] FIG. 3 shows in more details some inventive features and embodiments.

[0013] FIG. 4 shows in an embodiment the colour mixed adhesive at the side of a stack.

BRIEF DESCRIPTION WITH RESPECT TO DRAWINGS

[0014] A conventional prior art ribbon strap wrapper on a pack of currency notes is shown in FIG. 1. It is in the shape of a tape, which is shown to have sides A, B, C, and E, at 120 and 130. Any one of the sides overlaps another e.g. E overlaps A, partly or fully and is fused together by applying heat or is pasted together. The ribbon strap is tightly wrapped around a vertical axis to keep the stack together, as shown at 110. Still it is possible to pull notes from the wrapped bundle.

[0015] In the invented ribbon strap wrapper comprises preferably a removable adhesive, which glues the sides B1 and D1 of the notes when the wrapper is placed on the stack, as shown in FIG. 2. At 210 is shown a ribbon strap which can be preferably in the form of a removable pressure sensitive tape,
which has a higher amount of such adhesive on portions B1 and D1 which will bind the sides of the stack as shown at 250.

[0016] In the preferred embodiment, the adhesive on the portion of the strap in contact with the side of the stack of the sheets will be mixed with a colour to form a gel like substance to bind the substrate with the sheets. As shown in FIG. 4, the portion B of the stack in contact with the strap has such a gel like coloured adhesive (410). The thickness of this adhesive is higher than the thickness of colourless adhesive in the other portions of the strap not in contact with the sides but is in contact with one of the faces of the sheets, as explained earlier. This will leave some colour on the side of the notes but only in portion B usually (420) if the pack is opened conventionally i.e. by removing the strap. However, if an attempt is made to pull a sheet or a number of sheets from the stack as shown in 430, the rest of the portion A will also come in contact with coloured adhesive at B and will leave a mark AB on the side of the sheet (440). This will be useful in marking and detection of a sheet pilfered from a pack, resulting in better security of the pack.

[0017] The colour in the adhesive as mentioned above may be a visible colour or a colour invisible in normal conditions but visible in special conditions e.g. in special lights or otherwise detectable through spectrophotometric means. Such an adhesive with a special chemical or as above can be specially formulated colour in a thixotropic gel form and applied in a way that it releases colour due to pressure applied due to pulling of the sheet. Such special formulation may contain colour encased in a pressure sensitive membrane or granules, which break down and release the said chemical on the colour on the sheet being pulled and or adjoining areas as explained above. For example, food grade Silica Gel preferably in a thixotropic form can be suitably employed in this embodiment. In another embodiment, Gel pen inks may be employed, which may be further modified in its formulation to achieve desired properties e.g. viscosity. For example, the adhesive may be in gel form such as those used in removable museum gel adhesives, with a chemical indentifier, colour and other additives like water, polyvinyl alcohol, polyvinilpyrrolidone, polymers, defoamers etc. Such a gel can be formulated so as its viscosity breaks down under pressure.

[0018] However, in another embodiment it can be in the form of any other substrate such as in a conventional plastic band used to wrap a bundle of banknotes, on which an adhesive G is applied on sides B1 and D1 only and in that case the sides E1 and A1 can be fused or pasted together conventionally e.g. by application of heat. Alternatively, all sides can have the pressure sensitive removable adhesive uniformly or there can have higher thickness of adhesive on side portions (B1, D1), than other portions (A1, C1, E1). The ribbon strap also has preferably perforated or weakened tear lines or die-punched partial cuts across each surface shown as dotted cross lines at 230, so that after being once used the tape will disintegrate when unwrapped or tampered with. Such lines can be on a straight horizontal axis on the sides and on various angles on the front and back, as shown. If an attempt to pull a note or a number of notes is made without opening the strap, the strap will disintegrate. Alternatively the pilfered note as mentioned will get a streak of colour on its side extending right up to the top end of the sheet as shown in FIG. 4. If the colour is in a thixotropic gel form as explained earlier, it will form a smudge on the side glued to the strap and adjoining areas.

[0019] A flap without any adhesive preferably in a colour different from the rest of the substrate shown for example at E2 is provided for easy peeling off of the ribbon. The disclosed ribbon strap can be applied either along a vertical axis as shown at 210, or can be applied covering a larger portion of the two sides and another side completely, as shown at 310 and 320. At 310 the ribbon strap is a wide ribbon strap e.g. 2 inches wide, which fully covers a portion of the stack say e.g. one fifth, including the three sides. Alternatively, as shown in 320, a narrower ribbon strap e.g. 1 inch wide, is applied on the three sides, partially including two horizontal sides and one of the two vertical sides fully, as shown. Once a bundle of notes is packed like this, its sides in contact with the adhesive glues with the substrate and it becomes difficult to pull a note or a few notes from the bundle without either disintegrating the note or the ribbon. Yet the remaining portion of the bundle is free for being flipped for counting manually or on a counting machine, as indicated at 320. The ribbon strap can have suitable markings and disintegrates on opening.

[0020] The application of the strap as disclosed here can be suitably configured for a specific packaging line. For example, in a currency strapping operation, a gripper and a bundler is generally utilized to make packs of 100s. The strap conventionally used is either a plastic strap two ends of which are fused together to form the wrapper or glued together as in the case of a paper strap. In this case the bundler can comprise a spool of adhesive tape, which is wrapped around a bundle and then the bundle subjected to a pressure in case of a pressure sensitive and heat in case of a heat sensitive adhesives. The pressure can be applied either by an impact device or by application of a sustained weight, or heat may be applied utilizing an electrical heating device.

[0021] The strength and specifications of the gum as well as the substrate with tear lines can be adjusted to impart the necessary adhesion to the bundle in a way that if one tries to pull a note or a few notes from the bundle it will not come out without breaking the note or the strap, because the adhesion strength combined with the compressive strength in force will be more than the strength of either the sheet being pulled or the weakened strap. For example if a number of notes are pulled, the ribbon strap will break because of the said tear lines.

[0022] In another example embodiment, the individual sheets may additionally have a narrow band of repositionable adhesive on one of its sides like in Post-it® pads of 3M®, making it impossible to pull a sheet without breaking the ribbon as explained.

[0023] When the ribbon strap is peeled off, most or all of the removable adhesive will come out with it, though likely leaving some trace behind. The remaining adhesion between the individual leaves of notes due to such trace if any will be so low as to not cause any problem in unbundling the notes, also because when the notes from a pack from which ribbon strap has been removed will be likely pulled on a vertical axis to the adhered surface. Therefore the individual leaves of notes will come out easily.

[0024] The property of a removable adhesive to leave residual traces as above can be also effectively utilized by adding an invisible and difficult to decipher chemical in the adhesive which can be deciphered later as an additional information for detecting counterfeit. In addition, for example, a special dye such as a fluorescent dye, which glows in a particular light or another chemical with a distinct marker may be utilized. Further, various chemicals may be used in different
series and a log kept for cross-checking later the integrity of a particular note with a particular number supposed to have a chemical residue due to the adhesive band, as per the log.

[0025] In another embodiment, a heat sensitive removable adhesive can be used. In this case an applicator module will apply heat to make the adhesive glue the sides of the notes with the ribbon, as explained. In an alternative embodiment, a permanent adhesive or a repositionable permanent adhesive may be applied instead of a removable adhesive. Such adhesive form adhesion permanently so that the substrate cannot be removed after a specified passage of time, without destruction. In this embodiment, the permanent adhesive is utilized only on a portion which binds with a side of a stack and not on the rest of the portion viz. that which is in touch with a front or back of the notes, which can have a removable adhesive or may not have any adhesive and is fused together conventionally e.g. by heat application on plastic substrate. Despite the permanent adhesion of a small portion of a side of a note to the substrate of the strap, it will be possible to take out the notes once the strap is opened by pulling individual notes vertically from the bed of the stack, as is done in case of loosely bound notepad stacks. In yet another embodiment the adhesive used to adhere the sheets together is a permanent adhesive such as those used in binding-a note-pad stacks e.g. in office letter-pad, and a ribbon strap or tape with a removable-adhesive is pasted on top is the permanent adhesive lining fusing the edges of the sheets together. As a result, it will be impossible to pilfer a note from the bundle, and a leaf from the bundle could be taken out only after the strap with removable adhesive has been removed and then the leaves are pulled in a vertical direction to the pad, as is done in case of pulling an office letter-head from its pad.

[0026] As only a very small adhesion surface can be contemplated on the sides of the stack in contact with the adhesive, the tack, peel-strength, the storage modulus (G') of the adhesive will be suitably calibrated to have the desired level of integrity required. In the best embodiment a synthetic acrylic removable adhesive of low peel strength and high tack and thus a low G', such as those used in 3M® products is applied in a suitable thickness which will be generally higher than the thickness of glue in the conventional tapes made of such adhesives, e.g. 250 microns. Such adhesive usually contains a plasticiser and a tackifier amongst other constituents. For example, a mixture of water, acrylic polymer, stearic acid, sodium salt, polyethylene glycol, N-VINYLVRROLIDENONE-POLYMER, propanol, ether etc. used in making removable glue stick of 3M® may be utilized as the adhesive for this purpose. Likewise a suitable substrate such as a paper, vinyl or non-woven fabric tape can be used for making the ribbon strap with adhesives as above.

[0027] Various base polymers can be used in a removable pressure sensitive adhesive formulation since the rheological properties are significantly determined by the formulation (base polymer, plasticiser, tackifier and other additives) rather than the base polymers alone. Acrylic (water-based and solvent-based), natural rubber, and styrene block copolymers are the most popular base polymers in these formulations. Solvent and water based removable pressure sensitive adhesives are available from many suppliers including Avery Dennison®, Ichemco®, 3M®, and Mactac®.

[0028] The ribbon strap apart from being wrapped around a conventional vertical axis as shown in 110 and 240 can also be applied around the edges up to say for example one-fifth of its horizontal surface, as shown in 310 and 320, to impart additional pilfer-resistant integrity and yet letting the pack remain countable by flipping the individual notes by a conventional counting machine as shown at 330.

[0029] A special pressurizing device can be utilized to keep the strapped packs under vertical pressure to form the adhesion along the sides of the pack properly. This pressure device may apply a high impact for a short time or a moderate impact for a long time. The tightness with which the ribbon strap is wrapped around the bundle will also provide a pressure on the adhesive. Such tightness is calibrated at a level to apply a pressure yet not break down on the tear lines provided unless a pilferage attempt viz. to take out a note is made. This feature achieves three objectives (a) providing a pressure on the pressure sensitive adhesive for gluing; (b) providing compressive pressure on the stack; and (c) to provide a decompressive pressure on the strap to weaken its strength on the tear lines, increasing the possibility of its disintegration if an attempt for pilferage or tampering is made. The said tightness will depend on the type of the substrate of the ribbon, the adhesive and the type of the weakening e.g. perforation or cut.

[0030] The above method and devices can be most effectively utilized in banking operations especially in central bank treasuries where the notes are first printed. The disclosed invention can be suitably packaged as a part of currency printing machinery. Rolls of ribbons with adhesive portions as disclosed above can be applied after the notes have been printed and stacked in bundles e.g. of 100s. The ribbon strap can be applied through an automatic packaging machine. A pressure is applied on the ribbon strap to make the adhesive stick. The pressure can be applied by a short impact of high force or a long impact of moderate force e.g. keeping the adhered side portions of the packed notes under a weight of 1 kilogram per square centimeter for 10 seconds. To check the reliability of the pilfer-resistant property of the packs made as per the disclosures, a statistical quality control method can be applied whereby packs can be randomly selected and a note randomly selected form the said pack can be pulled applying a force, to measure shift from adhesion if any and take remedial measure as per a table. This aspect of the process can be suitably automated. For example, an alarm feature can trigger a supervisor to stop the packing line for taking corrective measures e.g. changing a ribbon strap spool, if a shift is determined beyond a specified tolerance.

[0031] The disclosures can also be applied to a modern currency counting machine, including a wrapping device accordingly. With suitable adaptations, the disclosures can be applied in many other packaging applications e.g. for bundling expensive cut sheets.

[0032] One of the technical problems the above invention solves is how to non-invasively make pilfer and tamper proof pack of sheet material so that it could still be counted by flipping without breaking the package. As disclosed above, use of adhesive will result in pilfer-resistant and use of weakened tear lines in tamper-resistant qualities. These apart form increasing reliability and accountability will also decrease the chances of unintended shifting of the sheets in a strapped pack, e.g. while transporting. It provides an effective substitute for stapling, avoiding its invasiveness. The disclosed device will work well with other security systems such as those that involve release of ink by pyrotechnic charge in a box of notes, on certain parameters being breached.

[0033] Thus it is evident that disclosed herein is a pilfer and tamper resistant ribbon strap for packaging sheet material including currency notes comprising a removable ribbon
strap (210, 220, 230) for wrapping bundles or stacks such as 100s of sheet material such as currency notes, the said strap having on at least a portion (B1, D1) of its surface an adhesive such as a pressure sensitive removable adhesive to bind at least one of the sides of the leaves (250) in the said bundle or stack to secure the said sheets from being pilfered or tampered. The said ribbon strap also comprises a perforated or weakened or punched tear lines on at least one of the said portion of the said strap, the said strap being disintegratable along at least one of the said lines, on at least one of the said sheets being pulled or removed from the said bundle or stack, or the strap being removed from the said bundle or stack. The said adhesive in the said strap can comprise invisible chemical markers identifiable by chemical analysis, for marking authenticity of the sheets, a colour visible under normal or specified conditions. The said adhesive, chemical or colour can be in a gel form, in particular a thixotropic gel form such as a silica thixotrope. Such gel can comprise polymers such as polyvinyl alcohol and polyvinylpyrrolidone, and additives such as water, defoamers, plasticizer and preservative; formulated so as its viscosity breaking down due to pressure applied on pilfering the bundle or stack. There can be a higher thickness of an adhesive on a portion (B1, D1) of said strap than another portion (A1, C1, E1) of the said strap, the said higher thickness of said adhesive being capable of adhering the said at least one of the sides of the leaves (250) of the said strap or bundle of sheets. The ribbon strap can be the form of a continuous roll of an adhesive tape, applicable on a bundle or stack of sheets.

 disclosed further is a method of forming a pilfer and tamper resistant packaging of a bundle or stack such as in 100s of a sheet material like currency notes comprising: wrapping the ribbon strap (210, 220, 230) around at least one axis of the bundle or the stack to adhere at least partially a portion of at least one of the sides (250) of each of the said stack, with a corresponding adhesive portion of the said ribbon, said adhesion being secured on applying a pressure or heat on the said adhesive portion in contact with the said side of the stack, the remaining portion remaining free for being counted by flipping the said notes in the said bundle. The above method can further comprise steps of determining integrity of the said pilfer resistant pack by randomly selecting a sheet from a pack, applying a measured pulling force on the said note, measuring shift of the said note and determining a value of integrity of the said pack in relation to the degree of the shift of the said sheet. Also disclosed is apparatus for pilfer and resistant packaging of sheets as above, comprising a gripping device, a bundling device, a measuring device, a wrapping device, a cutting device, a pressure or a heating device, a sensor device and an alarm device. Further an apparatus for testing the integrity of the pilfer and tamper resistant packs according to claim 8 comprising: a random sample picking device, a pulling device, a measuring device to measure the shift, a calculation device to arrive at an integrity score and an alarm device to signal a negative score if any is disclosed. These apparatus can be a part of a printing and packing assembly wherein the packaging apparatus is integrated with a printing line of sheets such as currency notes.

[0035] The present invention as herein narrated above and illustrated should not be read and construed in a restrictive manner as various adaptations, changes and modifications are possible within the scope and limit of the invention as defined and encompassed in the appended claims.

We claim:

1. A pilfer and tamper resistant ribbon strap for packaging sheet material including currency notes comprising:
   - a removable ribbon strap (210, 220, 230) for wrapping bundles or stacks such as 100s of sheet material such as currency notes, the said strap having on at least a portion (B1, D1) of its surface an adhesive such as a pressure sensitive removable adhesive to bind at least one of the sides of the leaves (250) in the said bundle or stack to secure the said sheets from being pilfered or tampered; a perforated or weakened or punched tear lines on at least one of the said portion of the said strap, the said strap being disintegratable along at least one of the said lines, on at least one of the said sheets being pulled or removed from the said bundle or stack, or the strap being removed from the said bundle or stack.

2. The ribbon strap according to claim 1, the said adhesive comprising an invisible chemical marker identifiable by chemical analysis, for marking authenticity of the sheets.

3. The ribbon strap according to claim 1, the said adhesive comprising a colour visible under normal or specified conditions.

4. The ribbon strap according to claim 1 to 3, the said adhesive, chemical or colour being in a gel form, in particular a thixotropic gel form such as a silica thixotrope.

5. The ribbon strap according to claim 4, the said gel comprising polymers such as polyvinyl alcohol and polyvinylpyrrolidone, and additives such as water, defoamers, plasticizer and preservative; the said gel formulated so as its viscosity breaking down due to pressure applied on pilfering the said bundle or stack.

6. The ribbon strap of the preceding claims comprising a higher thickness of an adhesive on a portion (B1, D1) of said strap than another portion of the said strap (A1, C1, E1), the said higher thickness of said adhesive being capable of adhering the said at least one of the sides of the leaves (250) of the said stack or bundle of sheets.

7. The ribbon strap according to the preceding claims, wherein the said ribbon strap is in the form of a continuous roll of an adhesive tape, applicable on a bundle or stack of sheets.

8. A method of forming a pilfer and tamper resistant packaging of a bundle or stack such as in 100s of a sheet material like currency notes comprising: wrapping the ribbon strap (210, 220, 230) around at least one axis of the bundle or the stack to adhere at least partially a portion of at least one of the sides (250) of each of the said stack, with a corresponding adhesive portion of the said ribbon, said adhesion being secured on applying a pressure or heat on the said adhesive portion in contact with the said side of the stack, the remaining portion remaining free for being counted by flipping the said notes in the said bundle.

9. The method of claim 7 further comprising determining integrity of the said pilfer resistant pack by randomly selecting a sheet from a pack, applying a measured pulling force on the said note, measuring shift of the said note and determining a value of integrity of the said pack in relation to the degree of the shift of the said sheet.

10. An apparatus for pilfer and resistant packaging of sheets as per claims 7 comprising a gripping device, a bundling device, a measuring device, a wrapping device, a cutting device, a pressure or a heating device, a sensor device and an alarm device.
11. An apparatus for testing the integrity of the pilfer and tamper resistant packs according to claim 8 comprising: a random sample picking device, a pulling device, a measuring device to measure the shift, a calculation device to arrive at an integrity score and an alarm device to signal a negative score if any.

12. The apparatus of claims 9 and 10, as a part of an automated printing and packing assembly wherein the said packaging and testing apparatus is integrated with a printing and packing line of sheets such as currency notes.

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