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U1S S1809

(56) Documents cited
GB 1550817 A

(58) Field of search
UK CL (Edition K) **B5N**
INT CL[5] **B32B**
Online databases: WPI

(54) Laminating metal sheet with printed resin film

(57) A method for continuously laminating a coiled metal sheet with a roll of a thin film of a synthetic resin, said film having at least two lanes of printed portions extending in the logitudinal direction of said film with an intermediate non-printed portion therebetween, whereby the leading end portion, by a pretermined length, of said film is bonded entirely to a portion of the metal sheet and only the printed portions of the rest of said film are bonded, immediately after removal of the non-printed portion therein, to the rest of said metal sheet.

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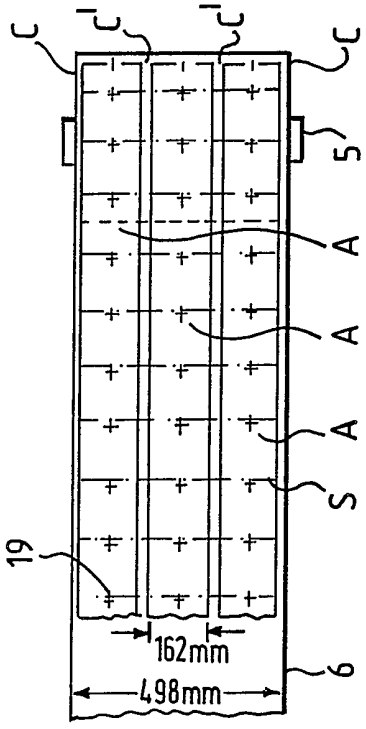

Fig.5.

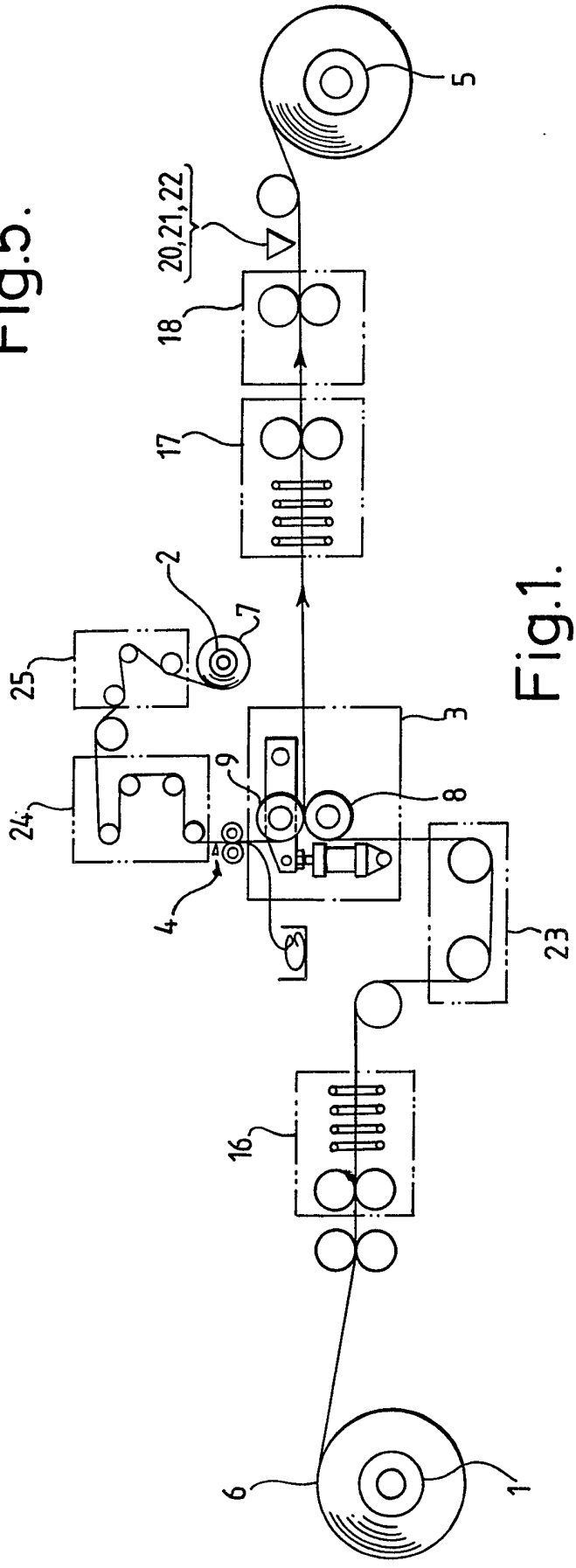

Fig.1.

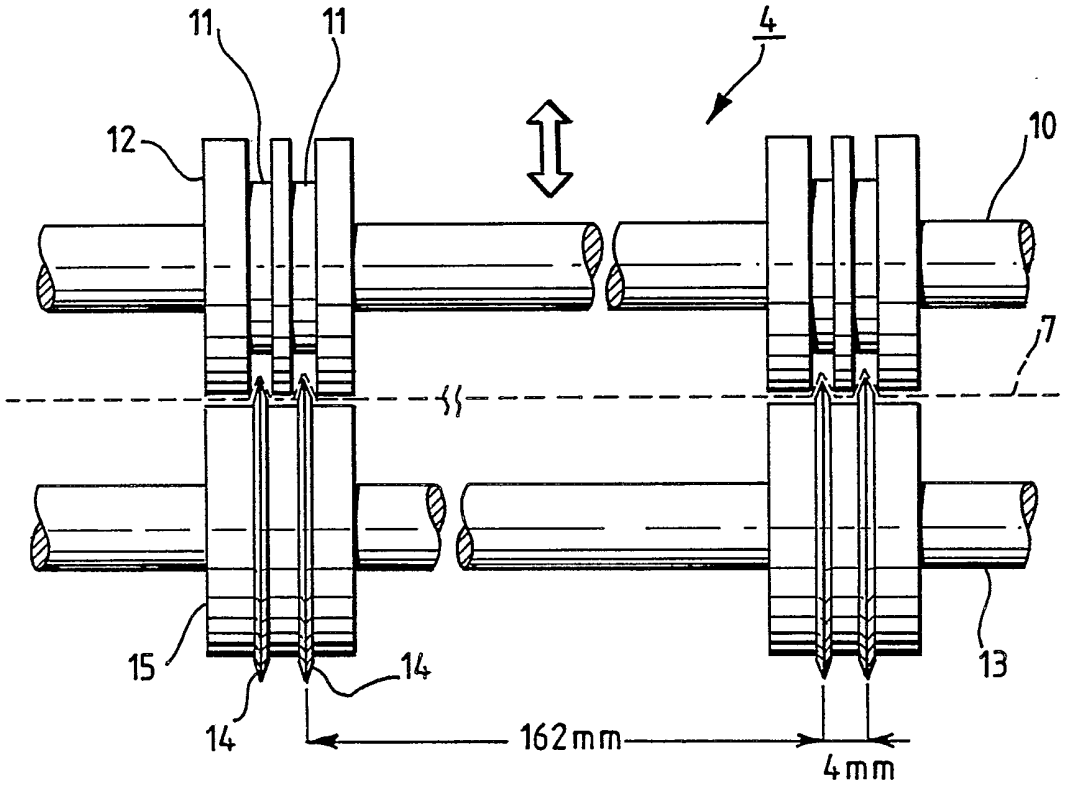

Fig.2.

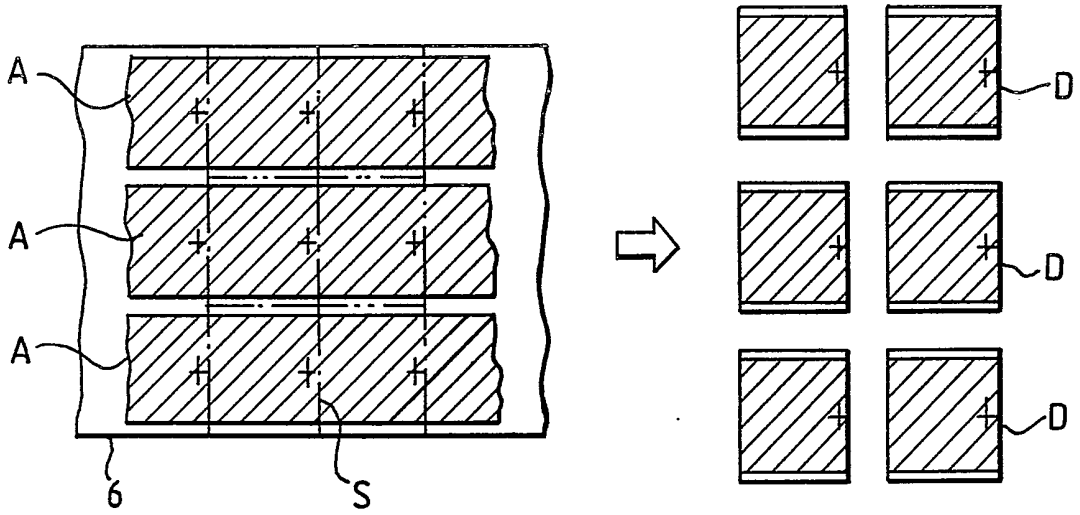

Fig.6.

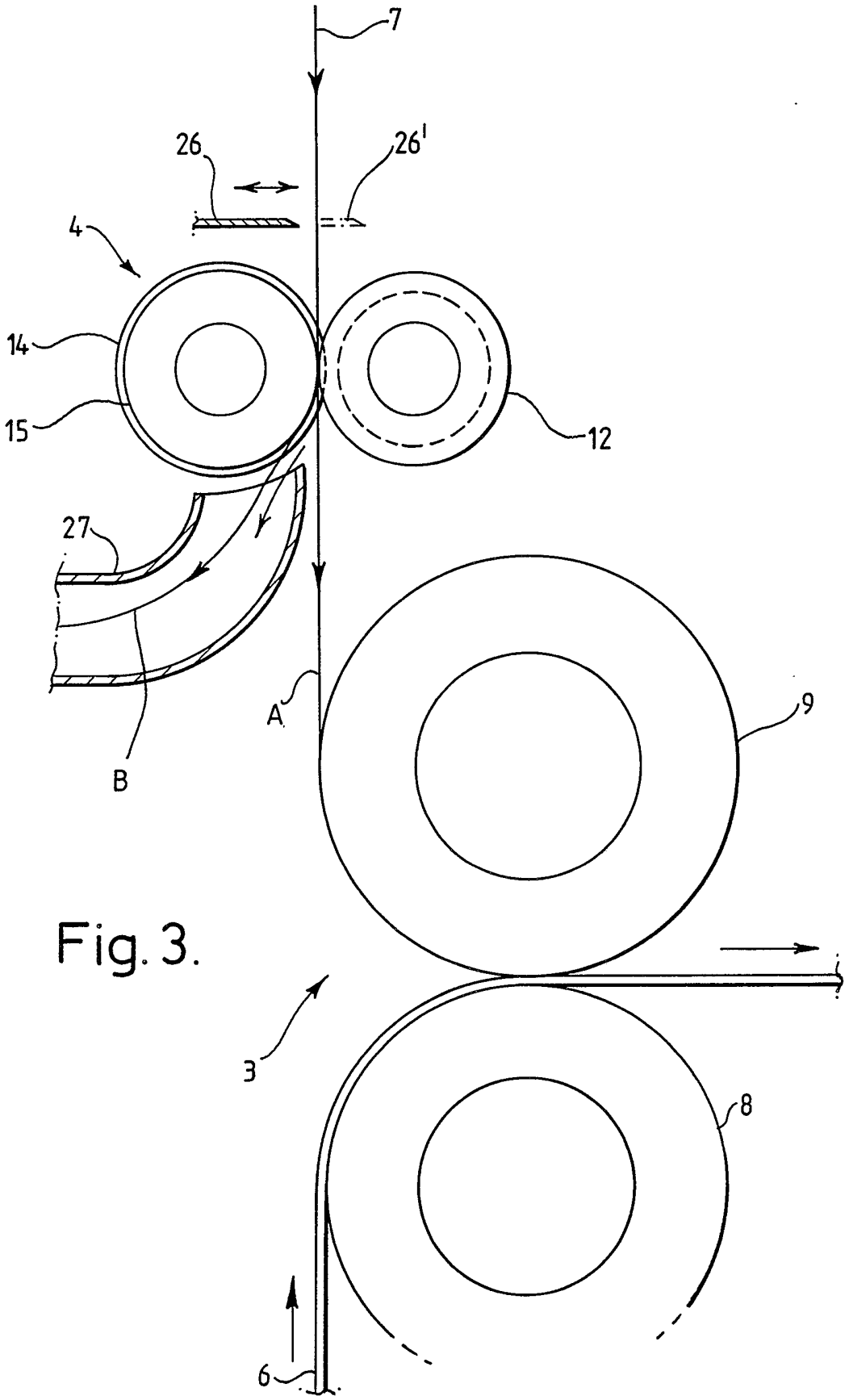

Fig. 3.

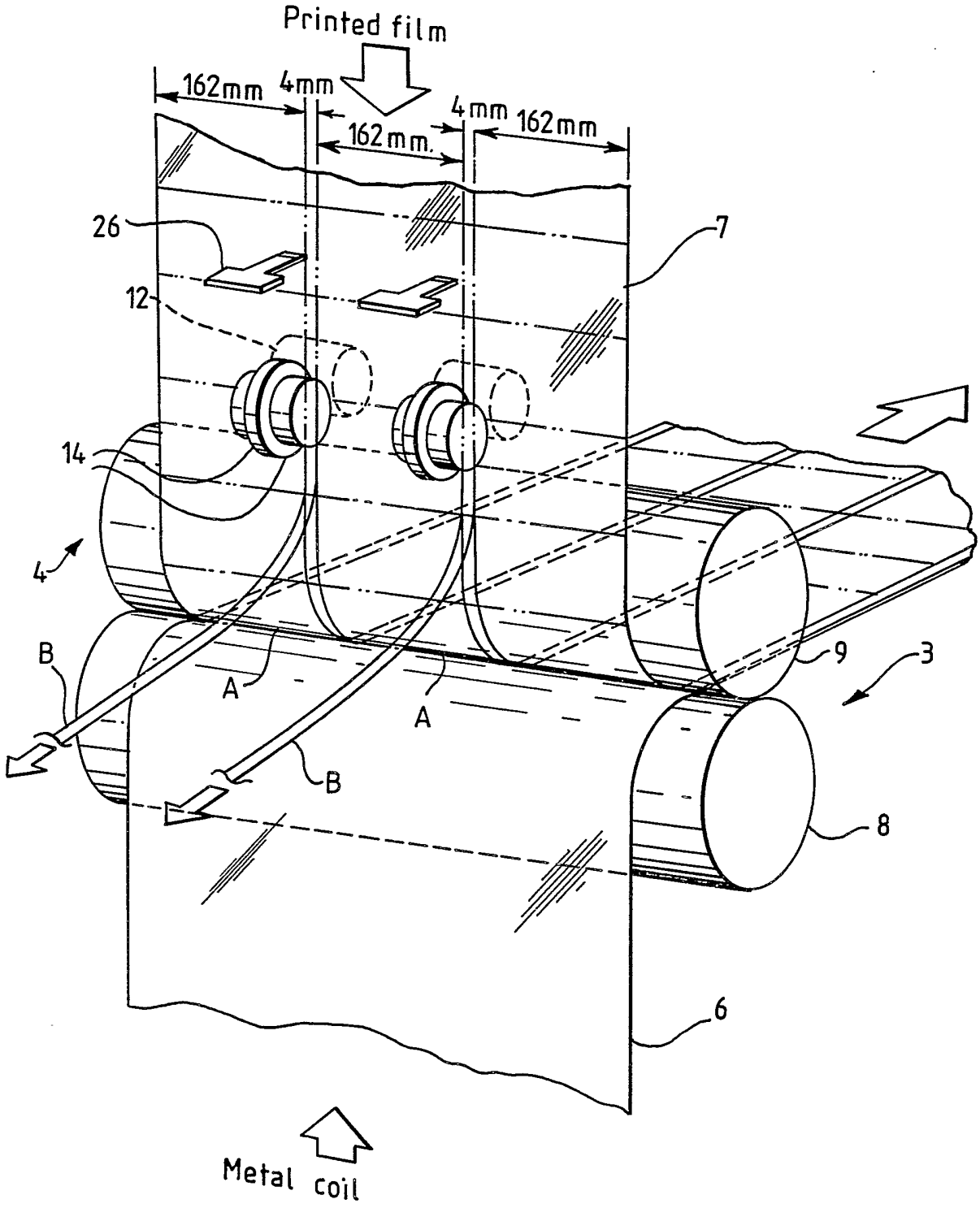
Printed film
162mm
4mm
162mm.
4mm
162mm
26
12
7
14
4
B
A
A
B
9
3
8
6
Metal coil

Fig.4.

TITLE OF THE INVENTION

METHOD FOR CONTINUOUSLY LAMINATING
A COILED METAL SHEET WITH A PRINTED FILM

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to a method for continuously laminating a coiled metal sheet with a rolled synthetic resin film having printed portions. More particularly, the invention relates to a method of continuously laminating with said film a coiled metal sheet to be used for producing welded cans.

2. Description of the Prior Art

Conventionally, three-piece metal cans used for canned foods and beverages have their outer surfaces provided with prints of various designs. To provide the cans with such printed designs, a coiled metal sheet is preliminarily cut into pieces of large rectangular sheets, which are then brought to a coating process in a can manufacturer for coating their inner and outer surfaces piece by piece. Subsequently, each rectangular sheet is gauged and printed on the outer surface mostly by means of off-set printing.

The above mentioned coating process is effected in such manner that when the rectangular sheet is cut into can body blanks, each such blank has weld margins free from a coating so as to form a welded seam. If the coating is applied to the entire surface of the rectangular sheet, the weld margins being covered with the coating will essentially result in a poor weld due to inadequate conductivity.

As the printing is effected over the coated surface of the sheet, it is necessary to perform accurate guaging of coated sheets piece by piece during the printing.

The off-set printing uses wetting water which is supplied to the surface of a printing plate so that hydrophilic portions (i.e., image-free protions) of the surface picks up the wetting water while image portions repell it, whereby a printing ink can be transferred only to the image portions. Thus, the image on the plate is transferred to a blanket cylinder and thence to a sheet to be printed.

Recently, can manufacturing techniques have evolved to the extent that substantial improvement of effeciency of coating and printing of can material is desired. However, the above mentioned off-set printing method has the following problems in achieving such substantial improvement of the efficiency.

(1) The wetting water supply control is essentially subject to the influence of the ambient humidity and temperature, and it is difficult to effect balanced control of an ink and wetting water. Therefore, the color of a print tends to vary particularly at start of a printing operation.

(2) Printing of metal sheets requires application of a high impression to ensure satisfactory transfer of a highly viscous ink and because of such high impression, printing equipment to be used essentially becomes sizable. Further, the guaging to be done for each sheet is subject to fluctuations, and the gauging accuracy is not sufficient.

For these reasons, it is difficult to achieve a high speed metal sheet printing operation, and available printing capacity has been limited to about 100 sheets per minute.

Accordingly, in an attempt to improve manufacturing efficiency in metal sheet coating and printing operations, the inventors tried a method of direct and continuous off-set

printing of a coiled metal sheet in lieu of the conventional printing of rectangular sheets piece by piece. However, the above trials revealed the following problems.

(3) Since a printing plate and a blanket are rolled round a plate cylinder and a blanket cylinder respectively, it is inevitable to have joins of both edges of the plate and the blanket respectively along the axial direction of the plate cylinder and the blanket cylinder and therefore, it is impossible to obtain continuous printing of repetative images at high speed without interruptions by-such joins.

(4) In multi-color printing, variations in the accuracy of the outside diamter of the printing cylinders and the blanket cylindes for individual colors cause accumulated effect of off-registration towards the trailing end of a coiled metal sheet to be printed.

(5) Since the printing a metal sheet requires high impression to ensure satisfactory transfer of a highly viscous ink, the guageing can not be adjusted during printing, and therefore the accumulated off registration can not be corrected.

Therefore, the inventors expected that a method of printing a rolled synthetic resign film in advance and continously laminating a coiled metal sheet with the printed film should be directly applicable to a coiled metal sheet for manufacturing welded cans and successfully solve the above problems.

There exist literatures describing prior art techniques pertaining to such lamination, and, for example, Japanese Patent Publication No. 13829/1989 discloses fabrication of drawn cans and lids by using a film laminated steel plate, which is obtained by bonding a thermosetting resing film such as a polyethylene telephthalate film to a steel plate.

The bonding of a printed polyester resin film to a metal sheet has been disclosed in Japanese Patent Publication No. 13828/1988, Japanese Patent Laid-Open Publication 236640/1988 and Japanese Patend Laid-Open Publication 55126/1990.

However, the steel sheet shown in the Japanese Patent Publication No. 13829/1989 has a resin film bonded to its entire surface and can not be used as a material for manufacturing can bodies that are fabricated by resistance seam welding or soldering as no organic resin should be present on those portions which form side seams of the can bodies.

The techniques disclosed in the above Japanese Publications No. 13828/1988, No. 236640/1988 and No. 55126/1990 feature an adhesive layer bonding together a metal plate and a resin film, and applications of the steel plate laminated with a printed film over its entire surface are construction materials and cases for electric products. This laminated steel plate can not be used for welded can bodies, in which no organic coating or synthetic resin film should be present on portions to form side seams.

British Patent Specification No. 1,550,817 shows lamination of a decorated plastic film and a metal strip, in which at least one edge of the film is cut at a position corresponding to an edge of the metal strip. However, since the film is bonded to the entire metal strip surface, again this technique can not be used directly for a material of welded cans.

Japanese Patent Laid-Open Publication No. 236954/1991 shows a film laminated steel strip used for a three-piece can and a method for manufacturing said strip. In the disclosed method, after a steel strip is plated with at least one of the elements Sn, Ni and Cr, a plurality of laminate films of a thermoplastic resin having a width corresponding to the height of the can are thermally bonded to one side of the steel strip such that they extend in the longitudinal

direction of a surface of the steel strip with a space of 2 to 5 mm provided between adjacent films.
Then, a thermosetting resin coating is applied to the other surface of the strip and dried while the strip is running.

However, the laminate films are free from any print, and in addition, it is very difficult, particularly at start of bonding, to apply a plurality of long thermoplastic resin films onto a steel strip correctly with a space of only 2 to 5 mm provided precisely between adjacent films, but there is no detailed teaching disclosed in Japanese Patend Laid-Open Publication No. 236954/1991. Lines 3 thorugh 20, upper left column of page 6 of said Publication describe that there are two alternatives to be employed with respect to the laminate films, i.e., to use those films that have been slit, in advance, to a size corresponding to the can height, or to use a wider film that is slit while it is being dispensed for bonding and in high speed lamination of 100m/min. or over, it is more preferable to use the films having been slit in advance. However there is no teachning about means for accurately bonding "the films having been slit in advance", or means for accurately bonding "a wider film that is slit while it is being dispensed".

OBJECT OF THE INVENTION

A main object of the invention is to provide a method for continuously laminating a coiled metal sheet with a roll of a printed film without causing difficulties in maintaining correct registration.

SUMMARY OF THE INVENTION

According to the invention, there is provided a method for continuously laminating a coiled metal sheet with a roll of a

printed synthetic resin film, comprising the steps of bonding the leading end portion, in a predetermined length, of the film having at least two lanes of printed portions extending in the length direction (i.e., feeding direction) of the film, said lanes of printed portions being spaced each other with an intermediate non-printed portion, entirely to a portion of the coiled metal sheet, slitting and removing the non-printed portions of the remaining film immediately before the printed portions therein are bonded onto the subsequent portion of the coiled metal sheet and bonding only the plurality of lanes of the printed positions of the remaining film to the rest of the coiled metal sheet in a uniform laminating condition.

The invention can be implemented without use of wetting water or printing plate, and after a predetermined length of the leading end portion of the synthetic resin film including the non-printed portions has been applied entirely to a portion of a coiled metal sheet, the plurlity of lanes of printed portions of the rest of the film are separated from the non-printed portions immediately before application to the subsequent portion of the coiled metal sheet, so that correct registration of the printed portions to the coiled metal sheet can be achieved readily and accurately and uniform tension of the film in its length direction can be maintained during lamination. The film-free portions of the laminated metal sheet corresponding to the non-printed portions to be cut and removed will become the weld margins of can body blanks to form welded seams of can bodies.

The above-mentioned and other objects and features of the invention will become apparent from the following detailed description taken in conjuction with the drawings which indicate an embodiment of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is a schematic view of a film lamination line in an embodiment of the invention;

Figure 2 is an elevational view showing a rotary cutter used for the embodiment;

Figure 3 is an enlarged fragmentary side view showing the major part of the portion in the line at which a film is about to be bonded in the embodiment;

Figure 4 is a perspective view of the part shown in Figure 3;

Figure 5 is a fragmentary plan view showing a coiled metal sheet laminated with the print portions of the film;

Figure 6 is a fragmentary plan view showing a can body blanks cut out from the laminated metal sheet.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

A preferred embodiment of the invention will now be described with reference to the accompanying drawings.

Figure 1 is a schematic view showing a film lamination line used in the method according to the invention.

A coiled metal sheet 6 on a metal sheet pay-off unit 1 is unrolled, taken through a lamination unit 3 and rewound by a metal sheet take-up unit 5. A rolled film 7 is unwound and dispensed from a film pay-off unit 2 and bonded to the metal sheet 6 in the lamination unit. The metal sheet 6 is a nickel-plated steel sheet having a width of 498 mm and a thickness of 0.2 mm and except for its portions to be used for forming welded seams of can bodies, its inner surface is coated in advance with a thermosetting epoxyphenol resin coating by a coil coater and its outer surface (i.e., surface to which a film is applied) is coated in advance with a thermosetting polyester resin coating including a titanium white pigment so that the metal sheet carries three lanes of coated portions on each of its surfaces. The fully coated coiled metal sheet is loaded on a pay-off reel of the pay-off unit 1.

Film 7 to be loaded on a pay-off reel of the pay-off unit 2, is biaxially oriented polyethylene telephthalate (PET) film having a width of 494 mm and a thickness of 12 microns coated in advance on one side with a thermosetting clear varnish of an acrylic acid resin in about 2-micron thickness and dried at 150°C or below.

The other side of the film is provided with three lanes of repetitive images of a print on a can body, said lanes extending in the length direction of the film, by means of a multi-color printing to be done by using a known gravure printer. In this embodiment, as shown in Fig. 4, the three lanes of printed portions A, each with a width of 162 mm, are provided on the film with two 4-mm wide non-printed portions B provided between each adjacent lane of printed portions A. In the last step of the gravure printing, the entire surface of the printed side of the film is coated by a gravure roller with an adhesive such as one which is mainly composed of a polyurethane resin, an acrylic acid resin or a polyester resin, each being a resin component of an ink, and then dried.

Film lamination unit 3 is provided with a pair of rollers, one being an inside warmable metal roller 8 and the other being a rubber roller 9 for urging the film 7 against the metal sheet 6. The metal roller 8 has a mirror finished surface and is driven by a drive unit (not shown). The roller 9 is a silicon-based heat-resistant rubber roller having shore hardness of 75 to 90 degrees.

Designated at 4 is a slitter for slitting the film 7 and separating the printed portions A from the non-printed portions B immediately before the film 7 enters the film lamination unit 3 and as shown in Figure 2, a plurality of rotating rollers 12 (in this embodiment, there are two rollers corresponding to two non-printed portions) each having two peripheral grooves 11 are fitted to a drive shaft 10. A rotating shaft 13, being arranged in parallel with the shaft 10 and movable inwardly and outwandly in relation thereto, carries a plurality of cutter assemblies 15 (in the same numbers as numbers of the rollers

12), each assembly having two rotary cutters 14 spaced each other by a predetermined amount (4 mm in this embodiment). When the outer periphery of each roller 12 and the outer periphery of the roller of each mating cutter assembly 15 are in contact with each other (that is, when the rotary cutter 14 is in a "closed" position), the edge of the cutter 14 is in a peripheral groove 11 of the roller 12. When each rotary cutter 14 is in an "open" position, the edge of the rotary cutter 14 stays away from the groove 11 of the roller 12.

Unit 16 in Figure 1 is a high frequency induction heater, which is provided as a pre-treatment unit for pre-heating the metal sheet 6, unrolled and fed from the pay-off unit 1, prior to the film lamination. The purpose of heater 16 is to warm the metal sheet 6, prior to lamination, up to a temperature close to the lamination temperature, i.e. the temperature at which the adhesive on the film reacts, as it is difficult to heat the metal sheet quickly and uniformly at a time up to the lamination temperature.

Unit 17 is another high frequency induction heater, which is provided as a post-treatment unit for curing the adhesive after bonding the film to the metal sheet and for removing stress produced in the film by bonding so as to stabilize and enhance the strength of the lamination.

After the high frequency induction heater 16 is provided a cooling unit 18 for removal of heat and expansion of the metal sheet. Since changes in the metal sheet temperature tend to cause quality problems due to fluctuations of tensile forces, suitable tension control units (not shown) may be provided in the pay-off and take-up units as necessary to eliminate such problems.

Members 20 and 21 are edge sensors provided at downstream of the post-treatment process. These edge sensors 20 and 21 detect a side edge of the metal sheet 6 and film 7 respectively. Members 23 and 24 are control units which control positioning of said edges being detected by sensors 20 and 21 before the metal sheet and the film enter the lamination unit 3, so as to accurately laminate the metal sheet with the film. In this

embodiment, the control units 23 and 24 perform such that the film 7, having a width of 494 mm, is bonded accurately to the metal sheet 6 of 498 mm in width, leaving a film free space C of 2 mm on each side of the metal sheet(Figure 5 does not necessarily show dimensional relation of the space with the overall size of the metal sheet).
Member 22 is a gauge sensor which, timed by pulses from a rotary encoder (not shown) mounted on the metal roller 8, detects gauging marks 19 (Figure 5) printed on the film 7 for compensating accumulated variations of pitches of the marks in the length direction of the metal sheet, and the tension of the film 7 is controlled by a control means (not shown) that adjusts paying-off force of the film pay-off unit 2 depending on pitches of the gauging marks being detected by sensor 22 and the film tension being detected by the film tension sonsor 25 provided on the discharge side of the film pay-off unit 2.

A specific example of the method of laminating a coiled metal sheet with a roll of a printed film in the above embodyment will now be described.

First, the coiled metal sheet 6, being unrolled by the pay-off unit 1, is heated to about 80°C in the high frequency induction heater 16, passed through the lamination unit 3 and taken up on the take-up unit 5. Meanwhile, the printed film 7, mounted on the pay-off unit 2 and centered substantially, in advance, on the center line of the metal sheet being unrolled, is unwound and dispensed from the pay-off unit 2, passed through the slitter 4 (the rotary cutters 14 being in the "open" position at this time) and taken into the lamination unit 3 so that the entire area of an edge portion (in a width of not less than 10 mm extending across the full width of the film) of a leading end portion of the film is urged against and bonded to the metal sheet 6 by means of the metal roller 8 heated to about 100 to 180°C and the rubber roller 9.

Subsequently the horizontal cutter 26, each having a 4 mm wide horizontal blade and being mounted on the upper portion of the slitter 4 as shown in Figures 3 and 4, are moved in horizontally

to a position shown at 26' so that the film is provided with cuts of 4 mm in length equal to the amount of the space between two adjacent rotary cutters 14. The cut length is set to 4 mm in this example for the reason that the width of the non-printed portions B proveded in the film 7 is 4 mm, and may of course be altered as required for different width of B. These cuts, extending across the running direction of the film are provided to facilitate the initial cutting of the non-printed portions B by the rotary cutters 14 and when the said cuts across the running direction are formed, the cutters 26 are moved out to their inoperative position and not used therafter until a new roll of a film is supplied.

After the horizontal cutters 26 are brought back to the initial inoperative position, the rotary cutters 14 are set in the "closed" position to cut the film 7 to remove the non-printed portions B while the film is being run through, so that only the printed portions A of the film are bonded continuously to the metal sheet while the non-printed portions B cut apart from the portions A are sucked by a discharge unit 27 (Figure 3) provided adjacent to the rotary cutters 14 and discharged toward a direction opposite to the running direction of the film. In this way, the three lanes of the printed portions A, A, A, separated one another are bonded continuously to the metal sheet 6 under the same laminating conditions.

The metal sheet 6 laminated with the three lanes of the printed portions A of the film, is subjected to aging (i.e., a process to stabilize the film adhesive) at about 200 to 230°C in the high frequency induction heater 17 (Figure 1) and then cooled in the cooling unit 18. The edges of the metal sheet 6 and the film 7 are detected by the sensors 20 and 21 and controlled and maintained in correct positions by the control units 23 and 24 depending on signals sent from the sensors 20 and 21. Position of the first gauge mark 19 of the film 7 to be detected by the sensor 22 is used as a reference point in determing off-registration of the film on the metal sheet and the sensor 22 is actuated to detect subsequent gauge marks for each of timing pulses (given at an interval corresponding to a given number of

the gauge marks 19) from the rotary encoder mounted on the metal roller 8. If a subsequent gauge mark being detect is not in the above mentioned reference point, the pay-off force of the pay-off unit 2 is changed to adjust tension of the film 7 being detected by the film tension sensor 25 so as to bring the rest of the gauge marks 19 to the reference point just when they are detected by the sensor 22. In this way, the metal sheet is laminated with the three lanes of printed portions of the film, all of which are precisely positioned and aligned across and in the longitudinal direction of the sheet with non-printed portions C' of a width of 4 mm therebetween and a 2 mm lamination free space extending along each edge of the metal sheet, as shown in Figure 5, and recoiled on the take-up unit 5. This recoiled metal sheet with the printed portions A of film 7 is slitted as shown by the parting lines S in Figure 6 into individual can body blanks D in a subsequent can manufacturing process. The portin of the metal sheet which carries the entire area of the leading end portion of the film (300 to 400 mm in length) is cut off and spoiled.

While the prior art off-set metal sheet printing process which can handle only about 100 rectangular metal sheets per minute, which are equivalent to 3,000 can body blanks of the size of 250g cans ordinarily produced from 30-out rectangular metal sheets, this embodiment with three lane lamination arrangements can have a capacity of about 200 m per minute covering about 4,400 pieces per minute of can body blanks for 250g cans of 136.5 mm flanged height, and thus, makes it possible to substantially improve the manufacturing output efficiency.

In this embodiment, the adhesive is applied to the film using a gravure roller in the final process of a gravure printing. However, this is by no means limitative and for instance, the adhesive may be applied to a printed film when such film is dispensed from the pay-off unit. In this case, a two-parts reaction type adhesive having an epoxy or polyester resin as its major component as used in a dry lamination process may be used.

Further, the metal sheet 6 is provided in this embodiment with a white coating on the side to which the printed PET films is bonded but such coating may be omitted, and also the three lanes of print portions A in this embodiment may be replaced by a greater number of lanes of printed portions and the manufacturing output efficiency can be further improved by increase of the number of such lanes.

Since a roll of a film can be printed by a gravure printing which needs no wetting water, a roll of a film with prints of stable quality is available for the method according to the invention and the images of the prints of metal sheets with a multi-color design in the prior off-set printing method that essentially involves a large number of steps, namely two or more passes in general when more than four different colors are in use, and large scale equipment can be readily obtained by the method according to the invention.

Further the method according to the invention offers substantial energy saving as drying the inks on a film (to be completed in 1 to 2 seconds by hot air at temperature of around 80°C) as used in this embodiment requires substantially less energy than drying the inks applied direct to a metal sheet usually requiring 5 to 7 minutes of baking at 180°C.

The film used according to the invention is preferably a thermoplastic resin film of polyester, polyamide, polypropyrene, or the like, having a highly heat-resistance to withstand the heat treatments in the manufacturing processes at temperature, for instance, of 200 to 260°C in can manufacturing and 125°C (for 30 minutes) in the food canning, and more preferably a biaxially oriented polyester film. The thermoplastic resin film may be coated with a thermosetting resin clear varnish as used in this embodiment to enhance greater economical advantages of the method according to the invention and satisfactory formability and mobility of the individual body blanks and welded cans in the can manufacturing and canning processes.

As has been described in the foregoing, according to the invention a coiled metal sheet with printed images of various designs for welded cans can be produced by laminating a coiled metal sheet with a plurality of lanes of printed portions of a roll of a printed synthetic resin film continuously and uniformly, and since said printed synthetic resin films is printed with said images by means of a gravure printing, which allows for ready adjustments during printing processes, in place of a conventional off-set printing which essentially involves wetting water and printing plates, said printed images with more stable quality and superior appearance of multiple color designs can be readily obtained. Also the method according to the invention offers improved efficiency in manufactuirng metal with printed images sheets as it is applicable directly and continuously to a coiled metal sheet.

Furthermore, in the method according to the invention of leading end portion of the printed film including both the printed and non-printed portions in a predetermined length is bonded entirely to a portion of the coiled metal sheet, the rest of the film is slit and separated into the printed portions and non-printed portions, and only the separated printed portions are bonded subsequently to the rest of the coiled metal sheet under uniform application conditions, so that precise registration of the printed portions at the time of the lamination can be readily obtained. While it is difficult to accurately laminate a coiled metal sheet with a plurality of rolls of lengthy printed films leaving a constant space (for instance 4 mm spaces) provided therebetween as envisioned by a prior art method, it is now necessary, according to the invention, only to register and apply a leading end portion of a printed film including printed and non-printed portions directly to a coiled metal sheet, so that the printed portions of the rest of the printed film are bonded automatically with a predetermined space provided between adjacent printed portions and thus troublesome positioning of the respective printed portions one after another is no longer required.

While there has been described what is at present considered to be the preferred embodiment of the invention, it will be understood that various modifications may be made therein, and it is intended to cover in the appended claims all such modifications as fall within the true spirit and scope of the invention.

CLAIMS:

1. A method of laminating a coiled metal sheet with a roll of a film of a synthetic resin, said film having at least two lanes of printed portions extending in its length direction with a lane of a non-printed portion provided therebetween, comprising the steps of bonding the leading end portion in a predetermined length of said film entirely to a portion of said metal sheet, slitting the rest of said film to remove said non-printed portion therein immediately before bonding the plurality of said printed portions therein and bonding the plurality of said printed portions continuously in a uniform laminating condition to the rest of said metal sheet.

2. The method according to claim 1, wherein said coiled metal sheet is used for manufacturing welded cans.

3. The method according to claims 1 or 2, wherein said print portions have repetitive images of a same design.

Examiner's report to the Comptroller under Section 17 (The Search Report)

Application number

9206500.2

Relevant Technical fields

(i) UK Cl (Edition K) B5N

(ii) Int CL (Edition 5) B32B

Search Examiner

P N DAVEY

Databases (see over)

(i) UK Patent Office

(ii) ONLINE DATABASES: WPI

Date of Search

17 JUNE 1992

Documents considered relevant following a search in respect of claims 1-3

Category (see over)	Identity of document and relevant passages	Relevant to claim(s)
A	GB 1550817 (BRITISH STEEL) - see whole document	1-3

Category	Identity of document and relevant passages	Relevant to claim(s)

Categories of documents

X: Document indicating lack of novelty or of inventive step.

Y: Document indicating lack of inventive step if combined with one or more other documents of the same category.

A: Document indicating technological background and/or state of the art.

P: Document published on or after the declared priority date but before the filing date of the present application.

E: Patent document published on or after, but with priority date earlier than, the filing date of the present application.

&: Member of the same patent family, corresponding document.

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