Oct. 14, 1941. H. C. FISHER ET AL 2,258,851

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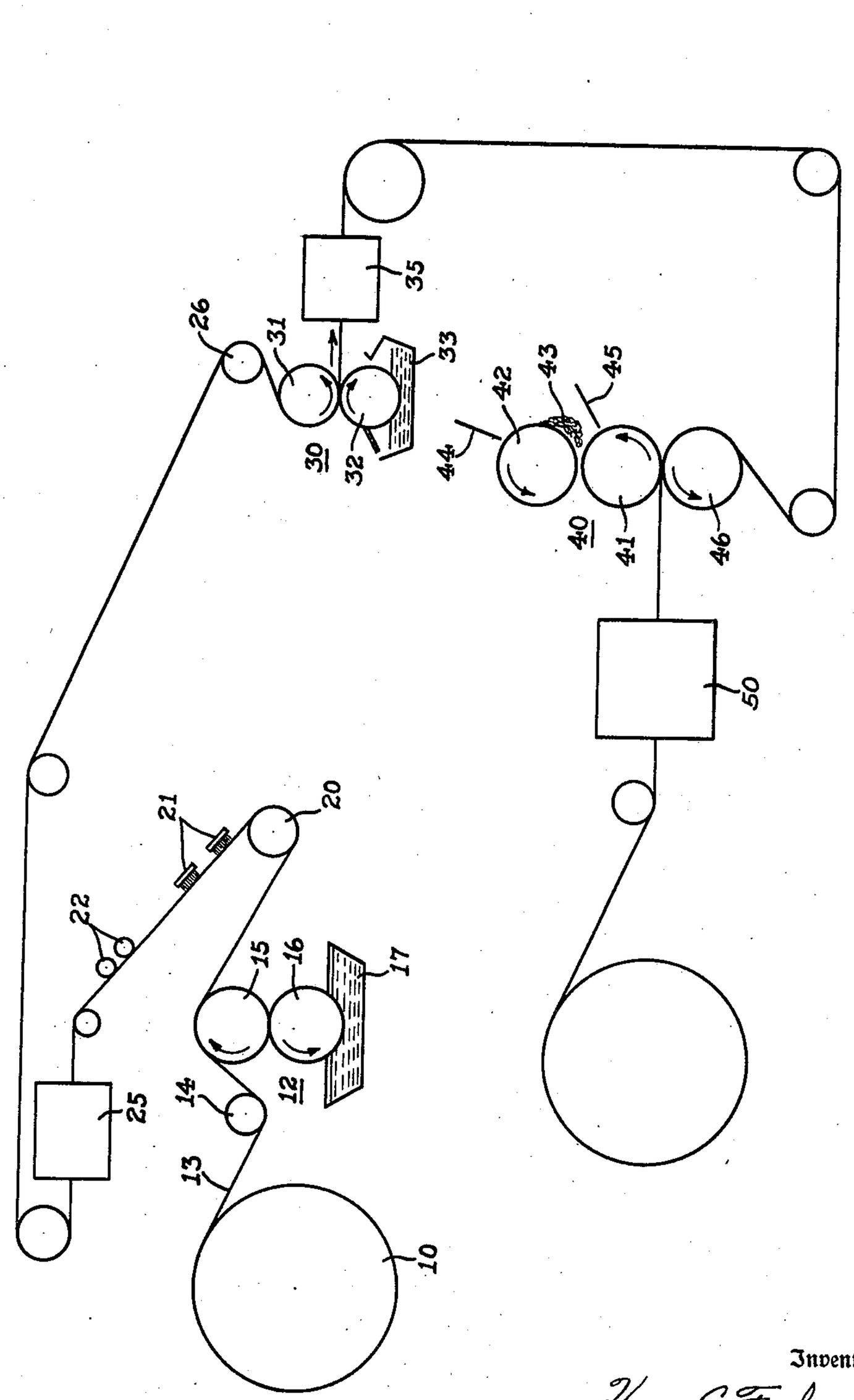
Filed Aug. 26, 1939



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Patented Oct. 14, 1941

2,258,851

UNITED STATES PATENT OFFICE

2,258,851

MANUFACTURE OF GREASEPROOF MATERIAL

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Application August 26, 1939, Serial No. 292,066

13 Claims. (Cl. 91—68)

This invention relates to the manufacture of paper and more particularly to the manufacture of paperboard for use in making cartons and the like.

It is a principal object of the invention to provide a process of this character for forming a highly greaseproof sheet of board adapted to be formed into the shape of a container body and to maintain its highly impervious characteristics to the passage of grease such as to be suitable for the packaging of oily and greasy products.

It is a further object to provide a process for effecting a composite greaseproof coating upon a sheet of paper including a lower highly flexible layer and an overlying highly greaseproof layer of adequate thickness and securely bonded to the lower coating layer such as to provide for maintaining the impervious character of the composite coating during operations incident to forming into the shape of the container and during use.

It is a still further object to provide a process for forming a sheet of paper having high flexibility and high greaseproofness and adapted for use in the manufacture of container bodies for oil and the like by applying a coating of lacquer of sufficient depth to provide adequate resistance to the penetration of the oil and securing the bonding of such lacquer coating to a lower coating so as to provide for maintaining the impervious character of the coating during flexing and bending of the sheet in use.

It is a further object to provide as a new product, a sheet of paper having a highly greaseproof and flexible surface coating thereon of adequate thickness to resist penetration of lubricating oils and like greasy materials and being sufficiently flexible to provide for the bending and forming of the sheet into the shape of a container body.

It is a still further object to provide as a new product a sheet of paper having a composite, flexible, and highly greaseproof surface coating thereon including a lower layer of high flexibility, and an overlying homogeneous layer of cellulose compound material having high grease-resisting properties, intimately and homogeneously bonded to the lower coating layer.

Other objects and advantages will be apparent from the following description, the appended claims, and the accompanying drawing.

In the drawing the single figure is a diagrammatic representation showing the steps in the formation of the sheet of paper.

Referring to the drawing which illustrates a preferred embodiment of the present invention, a roll of paper material is shown at 10. Such material is of a character adapted for use in the formation of the particular container body desired, and where a container is provided for the packaging of lubricating oil for example, such sheet of paper is selected to have adequate strength and stiffness, and a surface upon the side forming the interior of the container which is relatively smooth and of moderate finish. For reasons of economy, it is not practicable to provide an extremely high quality of surface upon such sheet, even though such surface will tend to facilitate the formation of a surface of high oil proofing characteristics; and in accordance with the present invention, a sheet of only moderate smoothness and finish and hence a less expensive sheet, is made to provide satisfactory results in the production of containers for such field of use. A particular product utilized for example is known as a test liner type of board, which is comparatively inexpensive, and which has high strength, but which does not have the maximum of smoothness and finish upon its surface.

In accordance with the present invention a sheet of this character is provided wth a composite coating upon the surface thereof having characteristics both of high flexibility and of high greaseproofness, the flexibility making it possible for the sheet to be formed and bent in the usual forming operations incident to the conversion of the sheet into a container body, and providing for maintaining the impervious surface film of greaseproofing material during such operations.

This composite coating preferably comprises a lower coating layer which is applied by means of coating press 12, the web 13 traveling from the roll 10 under guide roll 14 and into contact with the upper roll 15 of the press. The bottom roll 16 dips within a trough 17 containing the coating composition which is applied to form the lower coating layer.

The coating composition applied at this point is preferably one having high flexibility. It may also have characteristics of greaseproofness, although that is not an essential feature of the coating inasmuch as the greaseproofness is primarily imparted by reason of a subsequently applied overlying coating. A composition which has been found to produce very satisfactory results for application at this point is one comprising rubber latex, an oil insoluble adhesive such as sodium silicate, and an alkaline material such as ammonia or sodium hydroxide adapted to

maintain the composition in an alkaline condition. Rubber latex has qualities of elasticity and spreading ability and enables a relatively thin coating to be used with good covering power; it also functions satisfactorily to lay any fuzz which may be protruding from the surface of the paper and covers up irregularities, such as pores and pin holes, occurring in the surface. It is likewise a good moistureproofing and waterproofing material. The addition of the oil insoluble adhesive to the rubber latex imparts superior characteristics of adhesiveness and forms a highly satisfactory composition for this purpose. Instead of the alkali metal silicates, other oil insoluble adhesives may be used with highly satisfactory results including casein, various other animal or fish glues, or gelatin. A plasticizer such as glycerine, to assist the flexibility of the coating, may be included in the composition.

As an example of a very satisfactory coating composition for the base coat which is applied to the paper or board the following is mentioned: sodium silicate solution of about 38% strength preferably with a high ratio of silicon dioxide to sodium oxide (for example, at least 3.25 SiO_2 to one of Na_2O), and a rubber latex containing about 38% by weight of rubber hydrocarbons and the balance water and ammonia, are mixed in the proportions of about 60% or more by volume of rubber latex and 40% or less of sodium silicate solution to form the liquid coating composition. To this may be added a plasticizer, such as glycerine, e. g. 20 parts to 100 of the silicate-latex solution.

Illustrative of the composition employing casein as the oil insoluble adhesive in place of sodium silicate is the following. Thirty-one pounds of casein is dissolved in fifty gallons of water assisted by the alkaline action of one gallon of concentrated ammonium hydroxide solution. This is intermixed with 34 gallons of the 38% solids content rubber latex, one and one-quarter gallons of glycerine and three-quarter gallon of forty percent formaldehyde solution in water. After the materials have been thoroughly mixed, sufficient water is added to bring the volume to a total of one hundred gallons. This composition is applied on coating press 12 as described above.

The web 13 with such coating composition applied thereto then passes around guide roll 20 with its coated surface outward, and is then subjected to the action of brushes 21 and/or smoothing and spreading rolls 22 rotating against the travel of the paper, the purpose of which is to smooth and uniformly spread the surface of the coating composition upon the sheet of paper.

The sheet with the composite coating thereon is then passed through a drier 25 of suitable construction to provide for the directing of heated currents of air upon the coated surface of the sheet to cause drying of the same without adversely affecting the character of the coated surface of the sheet.

The sheet is then in condition for the application of an overlying coating, and this overlying coating is selected to have properties of high resistance to the penetration of grease, oils, and the like. Particularly in the case of a container for the packaging of lubricating oil, the material which has been found to produce most satisfactory results and to provide a surface capable of maintaining effective greaseproofness over the normal period of use of the container, is a cellulose ester, preferably nitrocellulose. Other suitable cellulose compounds or resinous materials, for example, cellulose acetate, vinylite resin, etc., may be utilized, such materials being applied in a film from a solution in organic solvents along with modifying agents, plasticizers, resins, etc., the film so applied having the desired high degree of resistance to the penetration of oil and grease which is important in an oil container. It has been found that it is important to secure the application to the sheet of a film of relatively substantial depth, and to have such film applied uniformly and smoothly so that the sheet will not have weak areas which are subject to failure. Obviously failure of the sheet in any particular area upon the part exposed to the contents will render the entire container useless, because of the penetrating action of lubricating oil in seeping and wicking through the body of the sheet once it penetrates the protective surfacing layer.

It is also highly important that such coating film of lacquer be applied to the sheet under such conditions that it will be securely bonded thereto, to provide for its retention in protective position during those operations incident to the formation of the sheet into the shape of a container. During such forming operations for example on modern production machines, a large roll of the paper material is fed to the machine which provides for slitting the sheet lengthwise into the form of a plurality of containers, and cutting the sheet transversely to provide a group of blanks, which are then simultaneously wound into the desired shape. It is essential that during these operations necessarily incident to the formation of the sheet the coating be and remain complete and impervious, without injury as a result of the slitting and cutting operations, and without rupture during the forming and winding operations.

In order to provide for the application to the sheet of a lacquer coating film having the very superior resistance to the penetration of grease as desired, use has been made of a reverse roll coating press in which a film of the lacquer coating composition is formed upon a roll in predetermined regulated and uniform depth, such film being thereafter carried into contact with and transferred to the surface of the sheet of paper moving in opposition thereto. This coating operation has been found to provide for the application of a film of the desired and predetermined thickness, by reason of the ability to adjust the thickness of the film formed upon the transfer roll, before that film is carried into contact with the sheet. And the transfer roll rotating in a direction opposite to that of the travel of the paper provides for the continuous and uniform transfer of that preformed film to the sheet, to in effect lay it down upon the sheet in its preformed condition and while maintaining the desired uniformity and homogeneity of the film.

However it has been found that the application of such coating film to the sheet of paper does not provide for securing the desired bonding characteristics between the film of lacquer and a sheet having a lower coating thereon of the character described above. More specifically, it has been found that where the sheet is formed in this manner, and a film of lacquer coating composition applied by a reverse coating press to the sheet containing the lower coating layer as specifically mentioned above, such sheet has good qualities of greaseproofness as formed, but

is unsatisfactory in that the lacquer coating film has a tendency to separate from or spall off the lower coating. This characteristic is particularly noticeable and objectionable along the edges of the sheet, after it has been cut into strips upon the forming machine, and while it is being prepared for winding into the final container form. The coating so applied appears to be insufficiently attached to the lower coat, and to be incapable of being bonded by normal operation of the reverse roll coating device.

However in accordance with the present invention applicants provide for forming a coating film which not only has the desired high greaseproofness and flexibility but which also is satisfactorily bonded to the surface of the sheet. For this purpose, applicants direct the web after passing through drier **25** over a guide roll **26** and into a coating press **30** comprising an upper roll **31**, and a lower roll **32** which dips within a trough **33**. The coating composition supplied to trough **33** is a material for forming a greaseproof surfacing film, and preferably of substantially the same character as that to be subsequently applied by the reverse roll coater for subsequently forming the outer surface of the sheet. Thus very satisfactory results are secured for example with the use of a solution of cellulose, such as the solution of a cellulose ester, for example nitrocellulose or cellulose acetate, along with the usual plasticizers, resins, etc., in an organic solvent. Likewise a solution may be formed utilizing an aqueous emulsion of cellulose material. Nitrocellulose is preferred on account of its relative cheapness and the ease with which the solution thereof can be prepared and applied by the use of inexpensive organic solvents and diluents such as ethyl and butyl acetate, acetone, alcohol, benzol, toluol, gasoline, etc.

The coating press **30** is operated to cause roll **32** to pick up a film of the lacquer upon its surface and to carry such film into contact with the sheet as it passes through the nip of the rolls. If desired the press rolls may be operated without weight, the pressure effective at the nip being merely that resulting from the weight of the rolls; or if desired the pressure may be increased by positive loading of the rolls to increase the effective pressure at the nip. In either case a considerable pressure per lineal inch of nip face is produced, and such pressure effective at the point of application of the lacquer coating not only limits the thickness of the film applied, but also appears to cause an intimate interbonding and interlocking relationship between the lacquer film and the coated surface of the sheet to take place. It is this incorporating pressure as developed in a coating press which is believed to provide for the enforced partial penetration of the lacquer film into and upon the lower coating layer which is thereby caused to bond itself to and become incorporated with such surface coating, and become incorporated with such surface coating and providing a surface film of lacquer.

It is usually preferred to utilize substantial pressure at the nip of the press rolls to form a relatively thin coating film, to secure proper bonding, and to avoid unnecessary usage of the lacquer coating composition. It has been found for example where proper control over the viscosity of the lacquer composition is maintained during the application of the coating to the sheet, that relatively high pressures may be utilized at the nip, and a very satisfactory covering power thereby provided. For example where the pressures effective at the nip were of the order of 50 to 70 pounds per lineal inch, coverages as high as 3500 to 4000 square feet per gallon have been secured.

Depending upon the drying characteristics of the lacquer applied by coating press **30**, the sheet of paper there coated may be passed directly to the reverse roll coater or first may require passage through a drier **35** of suitable construction to provide for the directing of heated currents of air upon the coated surface of the sheet to remove the organic liquids from the wet film and to convert it into a dry film.

The sheet of paper so formed is then passed directly to the reverse roll coater shown generally at **40** or it may be wound into a roll and stored before being additionally processed. This coater comprises a transfer roll **41** and a feed limiting roll **42** positioned thereabove. These rolls rotate in the same angular direction and hence their adjacent surfaces travel in a direction opposite to each other; rolls **41** and **42** preferably rotate at different speeds bearing a predetermined ratio with respect to each other, for example with roll **41** rotating at about 200% of the speed of roll **42**, their speed with respect to the travel of the sheet of paper being variable over a substantial range, roll **41** for example varying in speed from about 50% to 200% of the speed of travel of the paper, such variation in speed serving to regulate the quantity and smoothness of coating material applied. The lacquer material is supplied to the nip of the rolls by means of conduits or conveyors **43**, and a predetermined desired depth of film is formed upon transfer roll **41** in accordance with the spacing thereof from the regulating roll **42**. Roll **42** has a stationary doctor **44** associated therewith to clean the surface thereof after passing over the nip, so that it continually presents a clean surface as it comes over the nip. Roll **41** also has a fixed doctor **45** associated therewith immediately below the application device **43**, and serving to prevent passage of the coating material down the face of this roll.

With the film thus uniformly applied to the surface of roll **41**, it is carried around substantially without change and brought into transferring contact with the web of paper which passes over lower roll **46**. Roll **46** travels in the same direction as the web, while the surface of transfer roll **41** moves in a direction opposite to that of the travel of the paper. Hence the film of coating material preformed upon its surface is transferred to and upon the surface of the sheet, the spacing of rolls **41** and **46** being such as to provide for the proper support and engagement of the sheet with the transfer roll, but not such as to produce a high pressure with attendant friction and rubbing contact.

The coating composition applied at **43** is preferably of similar characteristics to that described above, comprising essentially a lacquer coating composition. Because this coating film is applied from an organic solvent and while still wet, over a previously applied surface applied from similar solvents, it readily attaches itself to and bonds intimately and homogeneously with the previous lacquer coating film, with the result that the coated sheet itself has essentially a single lacquer coating thereon. Such lacquer coating film however is not only uniform and homogeneous, and of the proper depth and thickness to provide the adequate degree of greaseproofness desired, but

also is so intimately bonded and keyed into the coated surface of the sheet that it does not tend to separate therefrom or spall off during forming or in use. Consequently a highly satisfactory product is produced, and in a simple and highly effective manner.

Following the application of the coating film by the reverse roll coater, the sheet is preferably passed through a drier 50 and may then be wound into the form of a roll preparatory to its final formation upon the forming machine into the shape of the container bodies desired.

While the process and product herein described constitute preferred embodiments of the invention, it is to be understood that the invention is not limited to this precise process and product, and that changes may be made therein without departing from the scope of the invention which is defined in the appended claims.

What is claimeed is:

1. A process for producing a paper product of the character described having high greaseproofness adapted for use in the formation of containers in the packaging of lubricating oil and the like comprising the steps of applying a lower coating material to the sheet of paper having characteristics of high flexibility, applying to said coated surface of the sheet a film of cellulose ester material under pressure such as to cause the cellulose ester film to bond securely to and key into the coated surface of the sheet, and thereafter forming a continuous uniform film of cellulose ester material and transferring the preformed film into contact with said previously applied cellulose ester film to cause formation of a homogeneous flexible surface coating of cellulose ester material intimately bonded to the sheet.

2. A process of the character described for effecting the application of a greaseproof surfacing film to a sheet of paper having a lower flexible surface coating thereon which comprises applying to said lower surface coating of the sheet a thin film of cellulose ester material under pressure such as to effect the intimate incorporation and bonding of said cellulose ester film with said flexible surface coating, and thereafter preforming a uniform film of cellulose ester material upon a moving surface, and bringing such moving surface into transferring contact with the previously coated surface of the sheet to thereby effect transfer of said preformed film in substantially its preformed condition as to uniformity to and upon the coated surface of the sheet to be maintained in secure relation with the sheet through the bonding action of said thin film of cellulose ester material.

3. A process of the character described for effecting the application of a greaseproof surfacing film to a sheet of paper having a lower flexible surface coating thereon which comprises applying to said lower surface coating of the sheet a thin film of cellulose ester material under pressure such as to effect the intimate incorporation and bonding of said cellulose ester film with said flexible surface coating, and thereafter preforming a uniform film of greater depth of cellulose ester material upon the surface of a transfer roll by feeding a solution of said material into the nip of said transfer roll and a feed limiting roll running in the opposite direction thereto, and bringing the moving surface of said transfer roll into transferring contact with the previously coated surface of the sheet to thereby effect transfer of said preformed film in substantially its preformed condition as to uniformity to and upon the coated surface of the sheet to be maintained in secure relation with the sheet through the bonding action of said thin film of cellulose ester material.

4. A process of the character described for effecting the application of a greaseproof surfacing film to a sheet of paper having a lower flexible surface coating thereon which comprises applying to said lower surface coating of the sheet a film of cellulose ester material under predetermined pressure such as to effect the intimate incorporation and bonding of said cellulose ester film with said flexible surface coating, and thereafter preforming a uniform film of cellulose ester material upon the surface of a transfer roll by feeding a solution of said material into the nip of said transfer roll and a feed limiting roll running in the opposite direction thereto, and bringing the moving surface of said transfer roll into transferring contact with the previously coated surface of the sheet by moving the sheet in the opposite direction to the surface thereof to thereby effect transfer of said preformed film in substantially its preformed condition as to uniformity to and upon the coated surface of the sheet.

5. A process of the character described for effecting the application of a greaseproof surfacing film to a sheet of paper having a lower flexible surface coating thereon which comprises applying to said lower surface coating of the sheet a lower coating of film-forming greaseproof cellulose material dissolved in an organic solvent under pressure such as to effect the intimate incorporation and bonding of the formed film to and upon said flexible surface coating, and thereafter preforming an overlying film of greaseproof cellulose material dissolved in an organic solvent by passage of a solution thereof through a nip composed of oppositely rotating rolls, and bringing such preformed film on the roll while still wet with solvent into transferring relation with the sheet to apply said preformed film as an overlying greaseproof coating onto said lower film to be intimately and homongeneously united with said lower film through the action of said solvent and maintained in secure bonded relation with said sheet of paper through the action of said lower film.

6. A process of the character described for effecting the application of a greaseproof surfacing film to a sheet of paper having a lower flexible surface coating thereon which comprises applying to said lower surface coating of the sheet a lower coating of film-forming greaseproof cellulose ester material dissolved in an organic solvent under pressure such as to effect the intimate incorporation and bonding of the formed film to and upon said flexible surface coating, drying the applied greaseproof film, thereafter preforming an overlying film of greaseproof cellulose ester material dissolved in an organic solvent by passage of a solution thereof through a nip composed of oppositely rotating rolls, and bringing such preformed film on the roll while still wet with solvent into transferring relation with the sheet to apply said preformed film as an overlying greaseproof coating onto said lower film, and drying said overlying coating to cause the same to be intimately and homogeneously united with said lower film through the action of said solvent and maintained in secure bonded relation with said sheet of paper through the action of said lower film.

7. A process of the character described for effecting the application of a greaseproof surfac-

ing film to a sheet of paper having a lower flexible surface coating thereon which comprises applying to said lower surface coating of the sheet in a coating press a lower film of cellulose material under pressure of the order of 50 to 70 pounds per linear inch of nip such as to effect the intimate incorporation and bonding of said cellulose film with said flexible surface coating, and thereafter preforming an overlying film of cellulose material by passage of a solution thereof through a nip composed of oppositely rotating rolls, and bring such preformed coating film into transferring relation with the sheet substantially free of pressure contact to apply said preformed film as an overlying coating onto said lower film to be homogeneously united therewith and maintained in secure bonded relation with said sheet of paper through the action of said lower film.

8. A process of the character described for effecting the application of a greaseproof surfacing film to a sheet of paper having a lower flexible surface coating thereon which comprises applying to said lower surface coating of the sheet a lower film of resinous material under pressure such as to effect the intimate incorporation and bonding of said resinous film with said flexible surface coating, and thereafter preforming an overlying film of resinous material by passage of a solution thereof through a nip composed of oppositely rotating rolls, and bringing such preformed coating film into transferring relation with the sheet substantially free of pressure contact to apply said preformed film as an overlying coating onto said lower film to be homogeneously united therewith and maintained in secure bonded relation with said sheet of paper through the action of said lower film.

9. A process of the character described for effecting the application of a greaseproof surfacing film to a sheet of paper having a lower flexible surface coating thereon which comprises applying to said lower surface coating of the sheet a film of cellulose ester material under pressure such as to effect the intimate incorporation and bonding of said cellulose ester film with said flexible surface coating, and thereafter forming a film of cellulose ester material of greater thickness than said previously applied film by passage of a solution thereof through a nip composed of oppositely rotating rolls and bringing such preformed coating film into transferring relation with the sheet substantially free of pressure contact and with the sheet traveling in a direction opposed to the direction of travel of the transfer surface at a predetermined relative speed, and regulating the quantity of preformed coating applied to the sheet by varying said relative speed.

10. A process of the character described for effecting the application of a greaseproof surfacing film to a sheet of paper having a lower flexible surface coating thereon which comprises applying to said lower surface coating of the sheet a film of cellulose ester material under pressure such as to effect the intimate incorporation and bonding of said cellulose ester film with said flexible surface coating, and thereafter forming a film of cellulose ester material by passage of a solution thereof through a nip composed of oppositely rotating rolls and bringing such preformed coating film into transferring relation with the sheet substantially free of pressure contact and with the sheet traveling in a direction opposed to the direction of travel of the transfer surface while the film is still wet so that said cellulose ester films are homogeneously united to each other upon the sheet of paper.

11. A process of the character described for effecting the application of a greaseproof surfacing film to a sheet of paper having a lower flexible surface coating thereon which comprises applying to said lower surface coating of the sheet a film of cellulose ester material under pressure such as to effect the intimate incorporation and bonding of said cellulose ester film with said flexible surface coating, and thereafter forming a film of cellulose ester material by passage of a solution thereof through a nip composed of oppositely rotating rolls and bringing such preformed coating film into transferring relation with the sheet substantially free of pressure contact and with the sheet traveling in a direction opposed to the direction of travel of the transfer surface while the film is still wet so that said cellulose ester films are homogeneously united to each other upon the sheet of paper, and drying said coating film in place upon said pressure applied film to form an effectively unitary, smooth and substantially uniform film of cellulose ester material securely bonded to said lower surface coating.

12. As a new product, a sheet of paper adapted for formation into container bodies for the packaging of lubricating oil and the like comprising a sheet of paper having a lower coating layer thereon having high flexibility and an effectively unitary greaseproof coating layer of cellulose ester material including a plurality of overlying films of cellulose ester material of which an inner film is intimately interengaged with and keyed into the lower coating layer, and of which an outer film is of greater thickness than the inner and intimately and homogeneously bonded thereto and retained in secure relation to the sheet thereby, said inner and outer films being homogeneously united to each other.

13. As a new product, a sheet of paper adapted for formation into container bodies for the packaging of lubricating oil and the like comprising a sheet of paper having a lower coating layer thereon having high flexibility and an effectively unitary greaseproof coating consisting of a plurality of overlying films of cellulose material of which an inner film is intimately interengaged and pressure incorporated with the lower coating layer, and of which an outer film applied in a wet condition over the inner film is intimately and homogeneously bonded to the inner film through solvent action and maintained on the sheet thereby.

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