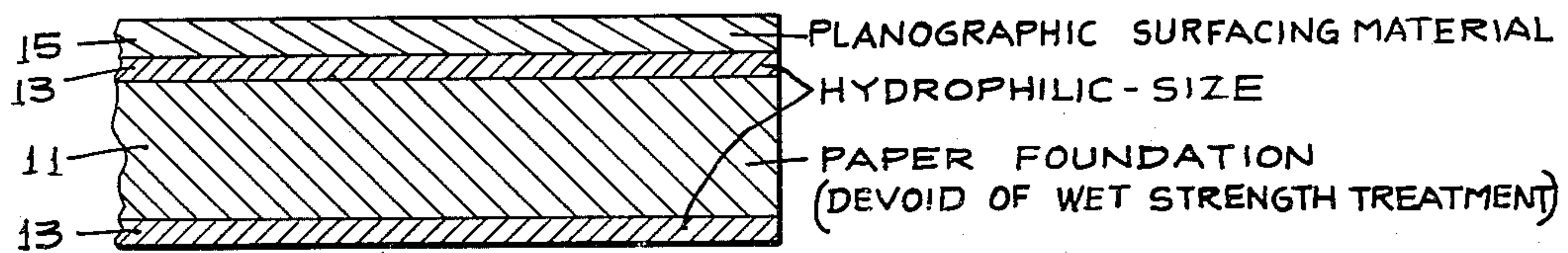


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PLANOGRAPHIC PRINTING

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This invention relates to planographic printing and to the construction of paper plates for use therein, and particularly in relation to their use in business systems, the present application forming a continuation in part of my application Serial No. 374,788, filed August 17, 1953, and now abandoned.

Heretofore it has been the practice in preparing paper-base planographic plates to impregnate the foundation sheet with melamine-formaldehyde or with some similar material in order to supply sufficient wet strength to enable the sheet to withstand the stress of press operation while in a continually moistened condition. This treatment, however, did not waterproof the sheet with regard to the absorption of water by the fibers which permitted the sheet to change shape, stretch and wrinkle during use. For this purpose a coating of waterproof nature was used to cover and seal the paper fibers, and the materials found useful for this purpose were uniformly ink-receptive to a marked degree. When this waterproof coating had been placed, it was covered by one or more printing surface coatings having the hydrophilic-oleophilic balance suited to the reception of a planographic imaging material, but repellent to oleous ink when moistened so as to give clean, background-free copies. Some of the binders which are most effective in preparing such coatings are the polysaccharide carboxy ethers such as carboxymethyl cellulose.

While plates made along the lines outlined in the foregoing paragraph have been found to furnish excellent results from the standpoint of printing quality and length of printing run, they have been so expensive as to preclude any possibility of their use in business systems applications. By the expression "business system use," it is intended to denote that the planographic plate shall be of such a nature as to serve either as a record sheet or a planographic master sheet, and that the cost shall not be excessive even though a large percentage of the sheets remain purely record sheets. Thus all of the work which may be under consideration may be written or printed on the sheets in question even though it is not known which items may later require duplication, and then only those items of which multiple copies are subsequently required will be used as printing masters.

It can be seen that the requirements of business systems use place an effective and very critical limitation of economy on the manufacture of a plate for this purpose, and heretofore it has not been found possible to construct an element which could satisfy this cost requirement and at the same time produce acceptable, high quality, background-free reproductions in restricted numbers, e.g. from 50 to 300 copies, when called upon to do so.

At this point it may be noted that, according to one plan of plate construction heretofore suggested, a printing surface treatment was applied to a base coating of a somewhat waterproofing nature, which in turn was carried by a paper foundation. This base coating consisted essentially in a material referred to as a hydro-

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philic adhesive charged with about four times its weight of a pigment such as clay, and mixed with a substantial amount of a hardening ingredient for the adhesive, such as dimethylol urea, to render it waterproof. Various hydrophilic adhesives were suggested for use in this connection, such as casein, glue, gelatin, soya bean protein, zein, insolubilized starch (presumably the "insolubilized" starch of trade which refers usually to corn or wheat starch which has been oxidized or chlorinated to make it more susceptible to a later insolubilizing treatment), polyvinyl alcohol and gum arabic. While it is correct to refer to these materials as "hydrophilic," since in the normal state they are water attractive, they are, especially when compounded with the prescribed amounts of pigment and methylol urea, also oleophilic. Furthermore, for the most part, they are then oleophilic to a degree such that, having been initially subjected to spaced local applications of both oleous material and water, and thereafter to substantially equal alternate general applications of oleous material and water, they will gradually take on more of the former to the ultimate displacement of the latter. That is to say, they are in the main preferentially oleophilic.

According to the present invention, it has been discovered that the wet-strength impregnation treatment of the foundation sheet is not necessary to a successful systems plate. It has also been discovered that the wet-strength treatments known and used contribute in a plural manner to the cost of the sheet, for not only does the cost of the material and its application to the sheet make up a considerable part of the sheet construction cost, but the fiber structure is, to some extent, affected by this treatment so that the sheet surface then requires even a heavier water barrier or waterproofing coating to cover the fiber ends and prevent the imbibition of water by the foundation which would cause stretch and distortion during the printing run. This water barrier coating is also usually required to insure proper attachment of the printing surface coating to the treated foundation, and it also adds materially to the cost of the sheet.

Due to the fact that suitable water barrier coatings are uniformly quite predominantly or preferentially oleophilic, it has further been found necessary to provide one or more heavy planographic surface coatings usually totaling at least eight to fourteen pounds per ream which will hide this tendency and prevent the formation of "tone" or "background" in the printed copies.

In the prior plate-making plan noted above, the suggested hydrophilic adhesive base coating is directed to be applied at a coating weight of about 12 pounds per ream, dry weight, per side, and experience has shown that this value, if workable at all, is a bare minimum amount for a coating of the type suggested from the standpoint of holding down and sealing the fibers of the foundation sheet, if no other special preliminary treatment for this purpose has been applied. Coatings of this nature and weight are not capable of being applied via the size tub of a paper-making machine and are invariably the subject of a separate coating treatment to the finished paper. Their very nature, therefore, offers at once a serious impairment to their utility as an effective part of a paper plate for systems use. Size tub applications of such coatings or sizings are limited as a practical matter to coatings whose dried residue amounts to a maximum of about three and one-half pounds per ream.

It has now been discovered that it is possible to dispense with both the wet-strength treatment of the foundation and the heavy, predominantly oleophilic, water barrier coating, or with the twelve pound pigmented adhesive base coating of the prior suggestion noted above. According to the present invention, either said wet-strength

and water barrier treatment or said pigmented hydrophilic adhesive base coating can be entirely replaced by a thin coating of a preferentially hydrophilic sizing material, at the same time providing ample water resistance to the sheet for a successful printing run of from 50 to 300 copies, at least. It has been discovered that certain preferentially hydrophilic water dispersible, but not readily soluble, sizing ingredients, when used substantially without fillers and without any significant amount of hardening ingredients (such as dimethylol urea), can be applied in amounts not in excess of 3½ pounds per ream (i.e. by tub sizing techniques) to an otherwise untreated paper sheet, with subsequent calendering, to give a foundation which readily accepts and holds the printing surface coating of the insolubilized polysaccharide carboxy ether type, and which in combination with the latter prevents excessive imbibition of water by the sheet during printing and provides absolutely clean background areas throughout a printing run of reasonable length for systems work.

The expression "preferentially hydrophilic" as used herein is to be distinguished from "preferentially oleophilic" as previously defined, and signifies a material or surface which, when initially subjected to spaced local applications of both oleous material and moisture, and thereafter to substantially equal alternate general applications of oleous material and water, will gradually take on more of the latter to the ultimate displacement of the former. The use of the unpigmented, unhardened, preferentially hydrophilic size, in combination with a calendering treatment, for some reason not entirely understood at present, is found to be capable of firmly laying and retaining the fiber ends of the paper, especially if the sheet has not first been subjected to wet-strength treatment, and thus producing a sheet whose rate of imbibition is very markedly reduced. This imbibition reduction is so marked that a single, light weight water-insoluble planographic surfacing coat of a polysaccharide carboxy ether composition and having a dry weight of less than six pounds per ream is sufficient to provide all of the water resistance necessary to give a normal systems length run (e.g. 300 copies) without destruction of the foundation and a printing surface durability such that the image is retained and clear copies can be obtained to the extent of at least 300 in number. Moreover the response of this new base coating to water for some reason does not impair the retention of the printing surface coating.

The preferentially hydrophilic properties of the base coating appear to contribute markedly to the success of the plate in two respects. First, the materials having this preferentially hydrophilic property appear to be partially swelled by the water in the printing surface coating during the latter's application, thereby commingling with the same ever so slightly, whereby the printing surface coating adheres firmly to the foundation without exhibiting any of the unfortunate tendency to crack or chip, sometimes exhibited by such coatings. Second, even with light-weight surface coatings as previously described, there is no tendency for the preliminary coating to "show through" or pick up ink during the printing process or to give an objectionable background tone to the copies. In addition, these base coating materials, when essentially free of significant amounts of hardening ingredients, such as formaldehyde or dimethylol urea, are capable of accepting the printing surface coat and even partially commingling therewith without detriment. The polysaccharide carboxy ethers, especially the preferred carboxymethyl cellulose compounds, react with such hardeners either at once or sometimes progressively upon aging to cause the printing surface to become more sensitive to ink and, without warning, unfit it for use as a printing plate. It is found sometimes that the presence of extremely small amounts of the hardener in fully reacted condition in the base coat may not prove detrimental to

the result, but for most purposes it is preferred to omit it altogether. The expression "substantially free" of such hardeners, therefore, is used herein to signify their absence except in such minor fully reacted condition.

It is therefore an object of the present invention to construct an effective yet inexpensive business systems planographic plate by coating on the paper-making machine a substantially untreated paper sheet with a preferentially hydrophilic size substantially free from pigments or hardening ingredients and not in excess of 3½ pounds per ream, dry weight, calendering the sheet, and then applying a thin planographic coating of a polysaccharide carboxy ether type to form the printing surface.

It has also been discovered that the printing surface coatings disclosed in my companion application Serial No. 380,446, filed September 16, 1953, now U.S. Patent No. 2,808,778, issued October 8, 1957, are particularly suited to use with the present invention, provide a printing surface which assists in rendering the foundation water resistant, and also provide a surface which can be quickly started on the press with little or no preliminary moistening treatment and little tendency to dry out during short periods of standing on the press. It is, therefore, another object of the invention to provide a business systems plate having a substantially untreated paper foundation, a calendered, preferentially hydrophilic size coating as set out in the immediately preceding paragraph, together with a surface printing coating in accordance with said companion application.

Additional features and advantages will hereinafter appear.

The single figure of the drawing is a diagrammatic section of a planographic printing plate made according to the present invention.

In carrying out the invention a suitable paper foundation web 11 is selected which may be of a fairly strong waterleaf paper or the like and preferably is a paper whose weight may be varied in accordance with cost warranted by the end use to which the sheet will be put. This paper is substantially untreated and is substantially devoid of wet strength imparting materials such as melamine-formaldehyde applied either to the pulp in the beaters or by subsequent impregnation.

The paper is treated with a preferentially hydrophilic sizing composition on one or both surfaces, preferably both. This operation, to make the cost of the finished sheet compatible with business systems use, is carried out in the size tub of the paper-making machine as a step in the paper-making process. The sizing composition is made up of water dispersible adhesive or binder material which is not too readily water-soluble and which may be any of various starch products such as corn starch, wheat starch, tapioca starch, soya bean starch, potato starch, rice starch or various water dispersible starch derivatives such as the "insolubilized" starch previously referred to. The composition is substantially free of filler, and should contain no hardening ingredients such as formaldehyde or dimethylol urea except for minute amounts which will rapidly assume a fully reacted condition with the binder. A suitable composition may be prepared by dispersing about four percent by weight of the starch product, e.g. corn starch, in water at about 160° F. The quantity of coating deposited on the web as it passes through the size tub amounts to a maximum of 3½ pounds per ream per side.

After leaving the sizing tub, the web is dried and calendered to produce a smooth surface substantially free of projecting absorptive fiber ends, the preliminary or sizing coat thus produced being indicated by numeral 13.

A planographic surface coating 15 is then applied to at least one surface of the web overlying the sizing or preliminary coating 13 and attaching itself thereto. The coating 15 may be applied by any suitable coating ap-

paratus such as a brush or air knife and preferably on one surface of the web only. The coating 15 is preferably very light and will not ordinarily exceed, for example, 6 pounds per ream when dry.

The properties required of the coating 15 are those required of any planographic surfacing material for paper plates, namely, that it be substantially water-insoluble, able to accept a planographic image when dry, and retain the same during printing, and that the background or non-imaged areas be hydrophilic and totally ink repellent when wet, i.e. it must have the hydrophilic-oleophilic balance necessary for planographic printing. The water-insoluble compounds of the polysaccharide carboxy ethers such as carboxymethyl cellulose have an especially suitable hydrophilic-oleophilic balance for this purpose. They may be coated on the sheet as water-soluble compounds and subsequently insolubilized by an after-treatment, as described in my Patent No. 2,655,864, or may be prepared with suitable insolubilizing ingredients included in the coating mixture.

A coating 15 which is especially preferred for making the plate of the present invention is one of the type described in my companion application, Serial No. 380,446, filed September 16, 1953, now U.S. Patent No. 2,808,778, issued October 8, 1957. In that application is disclosed the use of extremely lightweight coatings on the printing surface, e.g. from one-half to 6 pounds per ream and preferably between one-half and 4 pounds per ream. These coatings are suited to application to unusually smooth surfaces which are, in fact, important to their even and continuous application, and the sized and calendered surface presented by the sized foundation 11, 13 previously described in ideally suited to their reception.

According to said companion application it is beneficial to limit the filler content, such as china clay or the like, of the planographic printing layer to a minimum. This, it has been found, greatly helps in preventing transmission of moisture through the surface coating and into the foundation, and filler percentages based on the coating thickness as described in said application and shown below in Table A are accordingly preferably employed, since they will not adversely effect the acceptance by the coating of impressed carbon paper images.

TABLE A

Coating thickness (pounds per ream):	Approximate minimum ratio of absorbent filler to binder for holding carbon images
2-----	2:1
1-----	3:2
1/2-----	1:1

As further explained in my said companion application, a self-insolubilizing coating which uses primarily carboxymethyl cellulose as the film-forming ingredient is the preferred form of the invention, and suggested formulas for preparing coatings of this character are given as follows:

Example I

Sodium carboxymethyl cellulose-----	gr.--	2
Water -----	cc--	90
5% ammoniacal copper sulphate-----	cc--	40
Glycerine -----	gr--	1
Ammonium dichromate C.P.-----	gr--	0.75
Ferric ammonium citrate U.S.P. brown-----	gr--	1.0

Example II

Sodium carboxymethyl cellulose-----	gr.--	2
Water -----	cc--	90
Clay -----	gr--	8
5% ammoniacal copper sulphate-----	cc--	40
Glycerine -----	gr--	1
Ammonium dichromate C.P.-----	gr--	0.75
Ferric ammonium citrate U.S.P. brown-----	gr--	1.0

When either of the foregoing coatings 15 of Examples I and II are applied to the sized surface 13 of the foundation 11, they are dried and thus become insolubilized. Preferably the dry weight of the coating 15 should be between one-half and 4 pounds per ream. Such a coating may be placed either by a separate coating process or directly on the paper-making machine, preferably the latter.

When the coating 15 has been placed and dried, it is ready to receive image material as by typing; if desired, however, the web may be calendered again although this is not required.

From the foregoing description it can be seen that the present invention is such as to provide a sheet which is comparatively inexpensive and which can be used freely just as ordinary record sheets would be used, but which is at the same time capable of furnishing a large number, at least 300 in most cases, of clean sharp copies when employed as a master or plate in a planographic printing process. The economy of manufacture derives in part from the small number of treatments used and the light weight and consequent low cost of the coatings, but is greatly enhanced by the nature of the treatments which are such that a finished plate can receive all the treatments required directly on the paper-making machine in one single pass, or at most with one separate coating treatment, thus removing the costly factor of much re-winding and handling which is so substantial a portion of the cost of manufacturing the paper printing plates of acceptable quality, heretofore encountered.

When preparation of the plate 11, 13, 15 has been completed in accordance with the foregoing description, the cost of the sheet is, if at all, only slightly more than that of high grade record sheets, and may be used as such. The images which are formed by writing or typing on the sheet are placed on the surface which carries coating 15 (which may be lightly tinted if desired to indicate the proper surface) and are formed with a marking implement or typewriter ribbon which not only makes a legible mark, but which also provides a firmly adhering deposit of ink-receptive material. If this is done, any of the copies thus prepared can be withdrawn from the files at a later date, installed on the plate cylinder of a planographic printing machine and be alternately moistened and inked to print a large number of clean copies. If the life of the image is not fully used at one run, the plate may also be removed, dried, and saved for an additional printing run at a later date.

In the foregoing description and the subjoined claims, wherever it has been found necessary to refer to the thickness or weight of the paper or coating, these have been expressed in terms of "pounds per ream," which will be understood as indicating pounds per ream of 500 sheets, each 25" x 38".

Variations and modifications may be made within the scope of the claims and portions of the improvements may be used without others.

I claim:

1. A planographic plate for systems use consisting essentially of a paper foundation; a single preliminary coating; and a single printing surface coating in which said foundation is substantially free of wet strength impregnants, in which said preliminary coating is a calendered coating of a water dispersible but not readily water-soluble starch adhesive binder, is free of fillers and hardening ingredients, is preferentially hydrophilic, and has a weight not in excess of 3 1/2 pounds per ream per side whereby the fibers of said paper foundation are laid and retained in said preliminary coating and their rate of water imbibition substantially reduced, and in which the binder of said printing surface coating is essentially a water-insoluble image receptive compound of a polysaccharide carboxy ether.

2. The invention as set forth in claim 1 in which the

weight of the printing surface coating is not in excess of 6 pounds per ream per side.

3. The invention as set forth in claim 1 in which said printing surface coating binder is essentially the water-insoluble reaction product of a soluble carboxymethyl cellulose compound with admixed ammoniacal copper sulphate, ferric ammonium citrate and ammonium dichromate.

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