July 23, 1935. E. UHER ET AL 2,009,331

PROCESS FOR THE PRODUCTION OF RAISED PRINTING FORMS

Filed Nov. 3, 1932

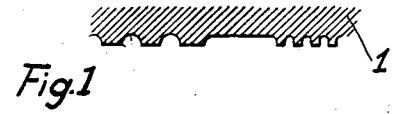

Fig.1

Fig.2

Fig.3

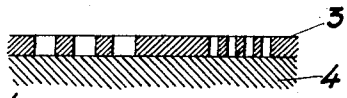

Fig.4

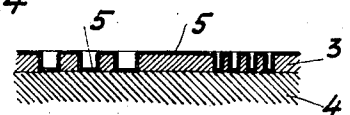

Fig.5

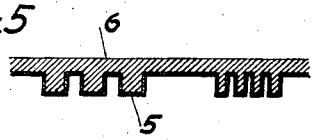

Fig.6

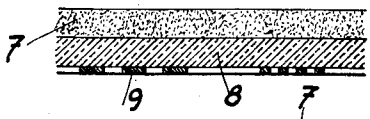

Fig.9

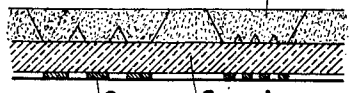

Fig.10

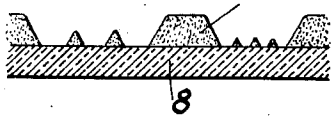

Fig.11

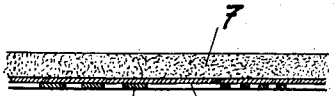

Fig.12

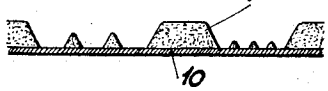

Fig.13

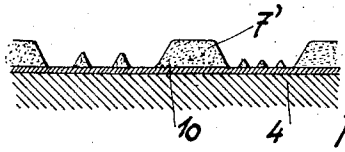

Fig.14

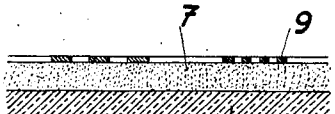

Fig.7

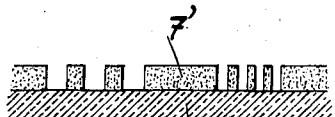

Fig.8

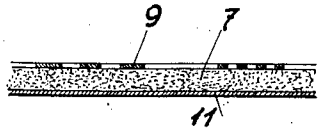

Fig.15

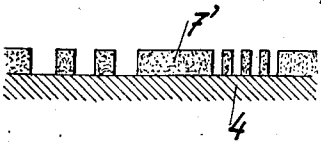

Fig.16

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PROCESS FOR THE PRODUCTION OF RAISED PRINTING FORMS

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Application November 3, 1932, Serial No. 641,099
In Germany November 9, 1931

1 Claim. (Cl. 41—25)

The invention relates to improvements in the process for the production of raised or in other words relief printing forms by moulding a solid matrix to reproduce black and white, as generally used for the usual kind of book printing. One object of the invention consists in carrying-out the preparatory treatment of the patterns required for the production of raised printing forms by purely photo-mechanical means in order to eliminate manual work and, in fact, all kinds of purely mechanical local work in this field. Another object of the invention consists in producing the pattern in such a manner as to enable each individual raised element projecting in an insular manner from the body of the printing form to be stabilized. Again another object of the invention consists in the employment of magnetic force for stretching out the patterns. A further object of the invention consists in the process of moulding the raised printing form by applying the material from which the form is to be produced by means of spraying. Again a further object of the invention consists in moulding the raised printing form while the pattern is in a wet or respectively swollen condition. Further details of the invention will appear in the course of the specification.

In the figures of the annexed drawing, examples of the various stages of progress in the raised printing forms in question or respectively of the patterns required for such production are shown. All figures are diagrammatical longitudinal sections.

Fig. 1 shows the relief of the raised printing form to be produced, whilst Fig. 2 shows the print obtained from such a form by the process of printing. These two figures will serve as directing examples for all of the following figures.

Fig. 3 shows a pierced pattern. In Fig. 4 it is shown how this pattern is converted by the addition of a supporting base, into a matrix from which the raised printing forms can be taken. Fig. 5 shows, how a raised crust is moulded from this matrix, whilst Fig. 6 shows the raised printing form lifted out from the matrix and reinforced by means of backing, i. e. of casting some plastic material into the cavities on its back side.

Fig. 7 shows a light-sensitive photographic plate on the top surface of which the diapositive picture of the raised printing form to be produced has been placed, whilst Fig. 8 shows the same photographic plate after photographic development and with the diapositive removed.

Fig. 9 shows how the diapositive picture of the raised printing form to be produced is placed below the bottom surface of the light-sensitive photographic plate. Fig. 10 shows how the light-sensitive photographic plate shown on Fig. 9 is exposed to light from below, and Fig. 11 shows the same photographic plate after photographic development and with the diapositive removed.

Fig. 12 shows a sheet of light-sensitive material applied on a film plate, with the diapositive picture of the raised printing form to be produced placed below the said film plate. Fig. 13 shows the same sheet and film after photographic development and with the diapositive removed. Fig. 14 shows the same sheet and film in its condition as shown on Fig. 13, placed on a supporting base.

Fig. 15 shows a sheet of light-sensitive material applied on a paper plate, with the diapositive picture of the raised printing form to be produced placed on the top of the same. Fig. 16 shows the same sheet of light sensitive material after photographic development, with the diapositive removed and the paper plate likewise removed, the developed sheet itself being squeegeed on to, i. e. transferred to the surface of a supporting base.

The problem to be solved is to produce a raised printing form, the relief 1 of which is such as shown on Fig. 1, and from which the print 2 shown on Fig. 2 can be printed on paper or on any other receptive material.

The various stages of the process according to the invention are illustrated diagrammatically on Figs. 3 to 6. Notably the raised printing form in question is produced, according to the invention, by the following steps: First of all a pattern 3 (Fig. 3) is provided by purely photo-mechanical means, which pattern is entirely pierced at those spots which correspond to the printing spots of the raised printing form to be produced, i. e. to those spots of the raised printing form to be produced which will project to the highest level from the body of that form. Following this the pattern is placed and tightly fitted on a base 4 (Fig. 4) which base is polished so as to be absolutely smooth and in exact conformity with the printing surface. The pierced pattern 3 will now jointly with the base 4 on which it has been placed constitute a matrix, on which the perforations of the pattern 3 will now no longer be open on both sides, but open on one side, notably towards the back side, only. The next step now consists in the perforations of the pattern 3 which are open towards the back side only, and the whole pattern 3 being coated by purely mechanical means, preferably by spraying, from above, with

a coat of plastic and subsequently hardening material until a coherent crust **5** (Fig. 5) is formed. Such coating may be effected by applying molten metal; instead of metal, however, celluloid, artificial resin or any other plastic and subsequently hardening material may be employed. This crust **5** constitutes the raised printing form desired, which is finally reinforced by casting some plastic and subsequently hardening material **6** (Fig. 6) into the back side cavities of the said crust either before or after removing it from the pattern **3**. The raised printing form can be removed from the pattern **3** without distorting its printing surface.

The process according to the invention therefore consists substantially in converting the front side of a pattern entirely pierced by purely photomechanical means at the printing points of any raised printing form desired—i. e. perforated in a negative sense relatively to the raised printing form desired—by means of a tightly fitting blind i. e. solid base into a matrix which is no longer open on both sides, but only open towards the back side, and in taking a mould from such matrix by purely mechanical means.

The patterns **3** may consist merely of a sheet of light-sensitive material, e. g. of a sheet of sensitized gelatine, which has been exposed to light with the aid of and in accordance with the diapositive picture of the raised printing form to be produced in such a manner, and subsequently has been developed and hardened in such a manner as to obtain the perforations required. The pattern **3** the perforations of which have thus been obtained by purely photo-mechanical means is then placed on a base **4**, in such a manner that the side of the pattern **3** which is in contact with the base **4** is that side of the said pattern on which at the preceding exposure of the light-sensitive sheet the diapositive picture of the raised printing form to be produced has been placed, or respectively which has faced the said diapositive picture. It is by proceeding in this manner that the sharpest contours will be obtained and that the reliefs obtained will reproduce the original most faithfully and with the highest degree of exactitude of dimensions when the crust **5** is subsequently moulded.

In this process, it is the printing spots, i. e. the spots projecting to the highest level from the body of the printing form, which will be shaped by the base **4**, or in other words, it is exactly those spots of the raised printing form, which will be shaped by the base **4**, which spots alone require to be produced in an accurate manner. As to the inaccuracies to which the layer of light-sensitive material is subject during the wet photographic treatment, the detrimental consequencies of such inaccuracies are according to the invention removed to the most far-reaching extent, as evidently the only places of the layer of light-sensitive material which are subject to such inaccuracies are now those places which correspond in the pattern **3** to the non-printing, i. e. to the deepest spots of the raised printing form, and any inaccuracies in these places are entirely irrelevant, as they have no effect whatever.

The preparation of the patterns **3** is effected by purely photographic means on the basis of diapositives of the line, reticulated or point type. The base **4** ensures the holding together of the pierced pattern **3** and transmits its accuracy direct to the printing spots of the raised printing form. The accuracy of the printing spots of the raised printing form is accordingly ensured by the accurate preliminary preparation of the base **4**. A base **4** polished so as to be accurately smooth, will furnish a raised printing form presenting an accurately flat printing surface. A base **4** on which hatchings, pointings or other particularities exist, will supply raised printing forms presenting the same particularities on the printing surface.

If the crust **5** is moulded by means of spraying, this will yield the advantage that moulding is effected under a certain pressure and that the particles introduced by spraying of the material used for moulding will remove the air from all corners and edges as well as from the finest perforations of the pattern **3** and will fill these in an absolutely accurate and true manner.

According to Fig. 7 the rather thick light-sensitive gelatine sheet **7** is carried by a plate **8**, which may for instance be a glass plate, and serves at the same time as a base, inasmuch as it is of continuous surface, resistant to pressure, and resistant to deformation and inasmuch as its sheet-carrying surface has been accurately machined beforehand in conformity with the printing surface which may be required in the given case. The sheet **7** is exposed to light by a contact process through the "line" type photo image **9**, which latter is a photographic diapositive picture of the raised printing form to be produced or respectively of the printed image which it is intended to print by means of the raised printing form to be produced, so that it is only those parts alone of the sheet **7** which are exposed to light, which parts in the pattern to be prepared from the same, correspond to the non-printing spots of the raised printing form to be produced. The sheet portions corresponding to the printing spots remain unexposed to light and are washed-out after the usual development and hardening of the sheet **7**. The sheet portions **7'** (Fig. 8) which are left over after this procedure correspond to the pattern **3** of the Figs. 3 and 4, as the spots reproducing the raised spots of the relief will appear as perforations and only the spots reproducing the deep spots of the relief will remain actually existent. The said plate **8**, again, corresponds to the base **4** of the Figs. 4 and 5, so that it is now possible to mould the printing relief required exactly in the same way as already described above in connection with Figs. 4 and 5.

Should the back-side boundary surface of the sheet portions **7'** show any irregularities for any reason whatever, for instance, owing to various deformations which they may have suffered during the photographic wet treatment, such irregularities are irrelevant for the raised printing forms as none but the non-printing parts of the printing relief, i. e. the places of interruption of the printing surface are affected by them.

In view of the fact that the glass plate **8** permits light to pass through it, the sheet **7** may also be exposed to light, by a contact process, according to Fig. 9 from below, i. e. from the front side of the pattern to be prepared, in order to make the contact lines of the perforations of the pattern as sharp as possible. Should the thickness of the glass plate **8** cause appreciable difficulties, exposure to light, from below likewise, may also be effected by means of the process of projection. The further photographic treatment of the pattern, as well as the moulding of the printing relief remain unchanged as described before. In case the sheet **7** is exposed to light from below, advantageously dispersed light is employed according to the invention, in which case the

portions of sheet best exposed to light will present conical shapes tapering upwards, as shown by means of the slanting lines traced in sheet 7 on Fig. 10. The consequence hereof is that after the removal of the portions unexposed to light and of the portions which are only exposed to diffused light to a less extent the pattern will be composed of sheet portions 7' (Fig. 11) all of which are of conical shape tapering upwards. A pattern of this kind presents the advantage that the perforations widening out funnel-shape are easily accessible from behind, and that the printing relief possesses stable individual printing spots and can easily be lifted out from the pattern. Another advantage is obtained for the raised printing form in this case by the fact that the depth of the non-printing spots results so to say proportional to their width, which fact acts as an automatic safeguard against the danger of smearing, i. e. against the danger of the wide non-printing portions of the raised printing form being accidentally also concurrently smeared with ink by the elastic inking rollers swelling out in those places and of the paper or the like, on which the printing is to be applied, being smeared over in consequence.

It is also possible, as shown on Fig. 12, to have the sensitized sheet carried by a film 10 instead of the said glass-plate 8 and exposed to light by a contact process from below, in the same way as in the preceding case, such exposure being notably again effected by means of dispersed light, so that after development a pattern according to Fig. 13 is obtained. The sheet-carriers permitting the passage of light through them, as the film 10 or the glass plate 8, may without detriment to the accuracy of printing surface aimed at, be frosted, in order to enable ordinary sources of light also to be used for a dispersed kind of lighting.

The pattern shown on Fig. 13 is before moulding the printing relief on it, stretched tightly on a base 4 (Fig. 14), for which purpose it is possible to previously soften the film 10 by moistening. The moulding of the printing relief is effected in the same manner as described before. The film 10 will behave in so pliable a manner, that the printing surface accuracy of the base 4 will through the mediation of the said film again be transmitted in its whole extent to the printing relief to be moulded. Instead of the film 10 other pliable sheet-carriers, for instance sheet-carriers made of paper, may also be employed. In case the sheet-carrier is opaque, exposure to light is effected by a contact process from above in the way shown in Fig. 7. It is also possible to employ pliable metallic sheet-carriers, for instance sheet-carriers consisting of blank calibrated sheet metal of about 0.2 to 0.4 mm. thickness, the employment of which will facilitate the handling of the pattern and particularly its removal from the raised printing form which has to be left intact in the state as it was moulded. If a sheet-carrier made of magnetic material, for instance of sheet steel is employed, this sheet carrier may be stretched over an iron base 4 by means of magnetic force, by which means it is possible to ensure a uniform and accurate coplanar adjustment.

According to Fig. 15 the sheet of light-sensitive material 7 carried by the paper 11 is exposed to light from above, by a contact process, through the "line" type photo image 9. Following this the sheet 7 is squeegeed directly on to a base 4, the paper 11 being at the same time pulled off, following which the sheet 7 is developed on the base 4 and washed out so that the pierced pattern shown on Fig. 16 and reminding of Fig. 8 is obtained. The difference is that that side of the sheet 7 which has been in contact with the "line" type photo image 9 has now, after the sheet 7 has been transferred on the base 4 and the paper 11 has been pulled off, been turned towards the bottom, in which position it forms the front side, i. e. the printing surface side of the pattern. By these means it will be possible to ensure the accuracy of an exposure to light effected, in accordance with Fig. 12, from below, in the case of an opaque layer carrier as well.

The raised printing forms may according to the invention not only be flat but may also be cylindrical. When producing cylindrical raised printing forms, e. g. rotary cylinders everything remains unchanged, as described and illustrated before, only the figures have to be considered partial longitudinal sections of cylinder shells, the sections being taken along a generatrix. The raised printing relief crusts or respectively the raised printing reliefs according to the invention may also be moulded in a flat condition and subsequently applied on a cylinder shell.

The printing relief may according to the invention be moulded direct from a wet or respectively swollen pattern, in which condition the light-sensitive sheet 7 forming the pattern will produce greater differences of height of relief and the intermediary time which would otherwise have been required for the drying of the sensitized layer is saved. Experiments have shown that it is also possible without any difficulty to spray the wet or respectively swollen patterns according to the invention with a liquid metal, evidently because the pulverized metal will in contact with air cool down rapidly and because the gradual growth of the thickness of the coat of metal will permit any vapours which may be formed to freely pass away.

It should be pointed out particularly, that light used for exposure from above of a sensitized sheet 7 which has not to be transferred has to pass through the said sheet entirely (Fig. 7), whilst in the case of a sheet 7 to be transferred being exposed to light from above (Fig. 15) as well as in the case of a sheet 7 not to be transferred being exposed to light from below (Figs. 9 and 12) it is sufficient to fix the depth of the exposure purely as demanded by the requirements of photographic technique, the essential thing being in each case to obtain from the sheet 7 by purely photo-mechanical means a pierced pattern with accurately coplanar front side (printing surface side) and with a substantially irrelevant back side.

Another point which should also be particularly emphasized is that in moulding the raised printing relief it is possible to apply not only a shaping pressure applied by means of the process of spraying but also a stamping pressure applied by means of stamping. Notably the base by the addition of which one side of the pattern perforated by purely photo-mechanical means is converted into a solid matrix is always resistant against pressure and deformation, and against a base of this kind it is always possible without any difficulty to apply a stamping pressure whilst the raised printing relief is still inside the pattern. For the same purpose it is possible to reinforce, by casting a suitable material into its back-side cavities, the raised printing relief crust already whilst it is still inside the pattern.

In case the layer of light-sensitive material is carried by a film plate, a paper plate or any other

pliable carrier, the latter will also have to serve the purpose of holding together in the correct position the particles of the pattern which in the already photographically perforated condition of the layer of light-sensitive material are mutually unconnected like so many small islets, and of facilitating the stretching on the base of the still continuous light-sensitive layer or respectively of the already photographically pierced pattern as well as the removal of the pattern from the raised printing relief moulded from the same, whilst maintaining the printing surface obtained. The carrier of the light-sensitive material which during the process of moulding remains between the base and the pattern has to be pliable to such an extent as to be capable of transmitting in its total extent the printing surface accuracy of the base to the raised printing relief to be moulded. The pliable layer carrier itself will of course have to correspond to the printing surface of the raised printing form to be produced. To the usual kinds of layer carriers as well as to bases on which a surface similar to that of layer carriers is provided the layer of light-sensitive material will adhere so closely at all points, that even the most minute pattern particles can everywhere remain perfectly accurate themselves.

What we claim is:

A process for the production of relief printing surfaces having a single discontinuous printing plane, consisting in converting a light-sensitive colloid layer on a flexible support into a stencil pattern by photographic means, said stencil pattern being completely pierced at the places corresponding to the raised portions of the printing surface, applying the stencil pattern to a rigid support having a very accurate plane surface to correspond to the printing plane of the printing surface to be produced, with the flexible support interposed between the colloid layer and the rigid support and forming the printing surface by applying a moulding material to the said stencil pattern whereby the discontinuous printing plane of the printing surface is formed by the moulding material which comes into contact with the exposed portions of the rigid support at the bottom of the pierced openings of the stencil pattern.

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