Feb. 16, 1932. M. PARTIOT 1,845,553

FABRIC PRINTING MACHINE

Filed July 21, 1930 2 Sheets-Sheet 1

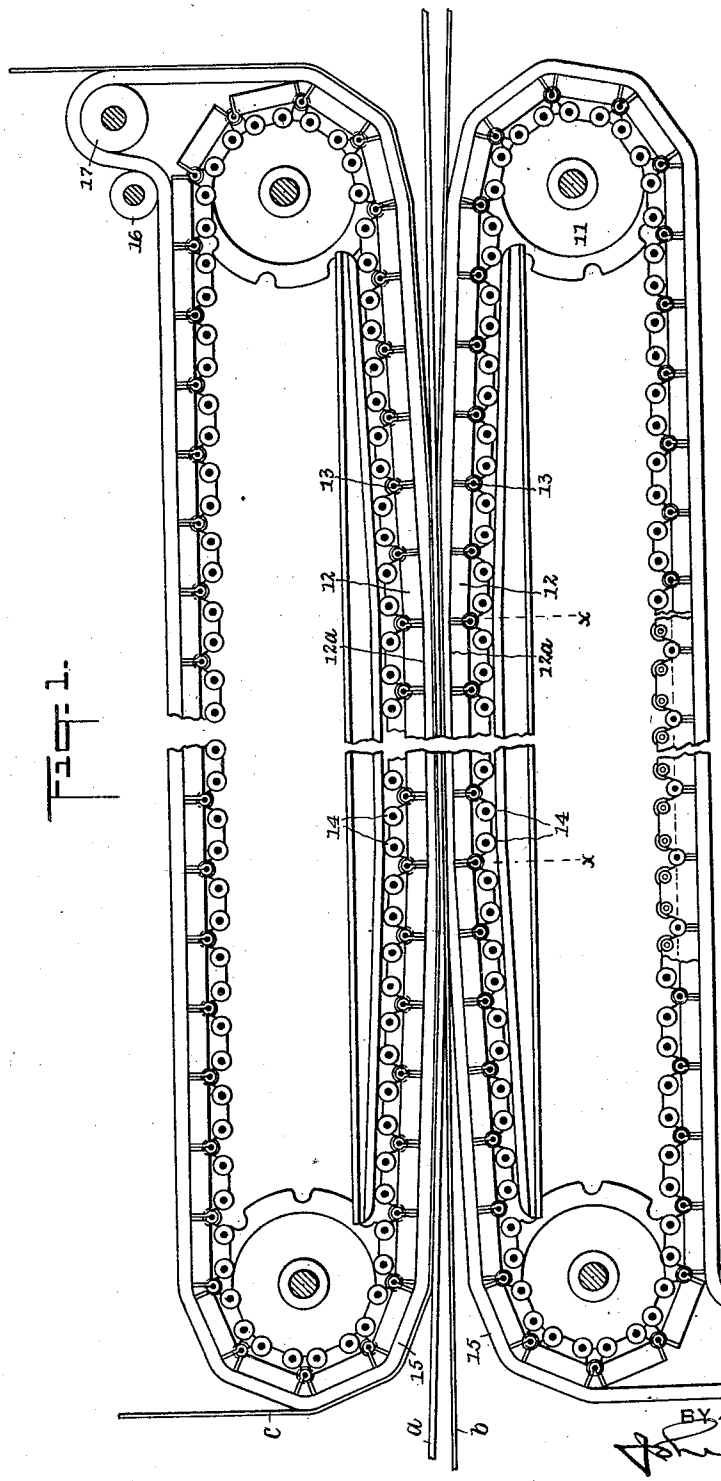

Fig. 1.

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Fig. 2.

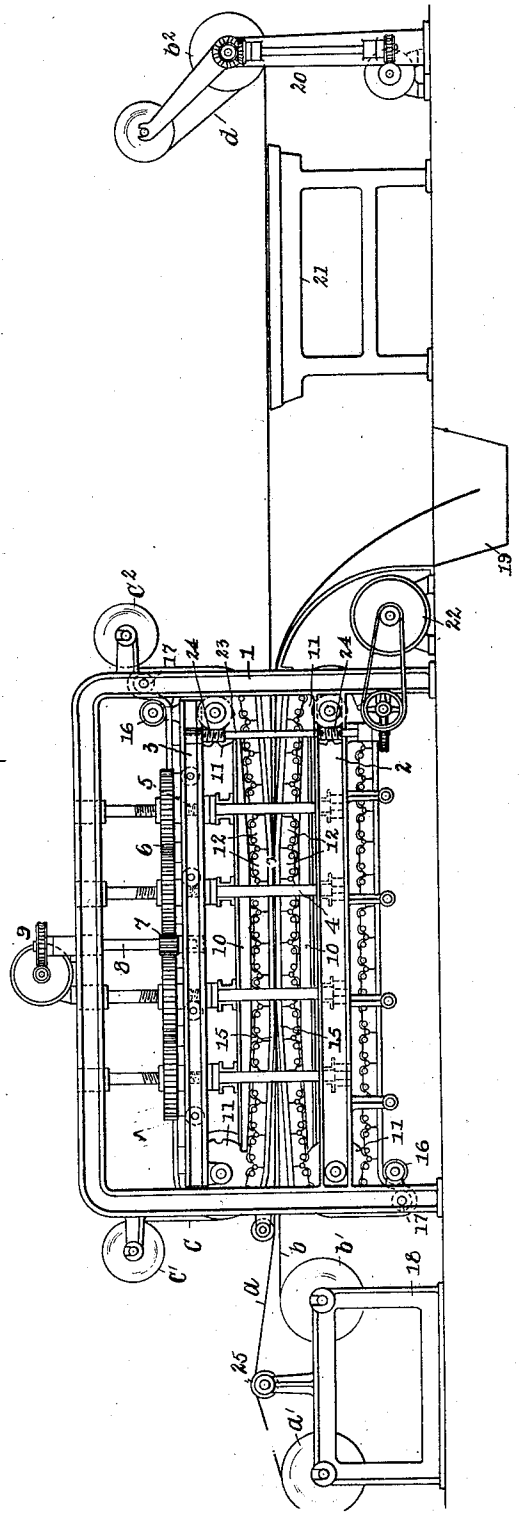


Fig. 6.

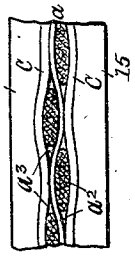


Fig. 5.



Fig. 4.

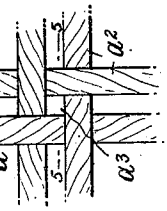
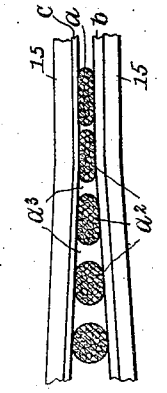


Fig. 3.



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Patented Feb. 16, 1932 1,845,553

UNITED STATES PATENT OFFICE

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FABRIC PRINTING MACHINE

Application filed July 21, 1930. Serial No. 469,354.

This invention relates to transfer printing. My principal object is to provide for the printing of absorbent material, and particularly fabrics, in such a way as to obtain the advantages of platen printing (or printing involving reciprocation to obtain the printing pressure) and of roller printing without the disadvantages of these classes of printing. Otherwise stated, I aim to accomplish transfer printing by an operation in which the sheet being printed and the transfer sheet are made to travel while pressed together and in surface as distinct from line contact with each other, thereby obtaining the expediting of production which characterizes roller printing and affording the necessary time for the transfer to operate fully which is possible by platen printing and is impossible by roller printing due to the mere line-to-line contact of the rollers. In the practice of my invention I can attain continuity of action for any desired length of the sheet to be printed which characterizes roller printing and which of course is impossible in the case of platen printing.

In carrying out my invention I employ pressure means coactive to exert compression on the interposed transfer sheet and sheet to be printed and having pressure areas continuously active to hold the sheets in part in surface to surface (as distinct from line to line) contact with each other and at least one of which means includes an endless and flexible pressure structure movable in its own circuit to advance the sheets between said means edgewise of themselves. In the preferred adaptation one or more of the following features characterizes the invention, to wit: that at least one of said structures is elastically yielding and preferably formed of elastic yielding material, so as among other advantages not only to insure intimacy of contact of the two sheets (both of which are of course flexible) but, as will appear, and especially in the case of fabrics to be printed that are of cellular or interstitial structure, to effect entrapping in its cells and the maintaining localized and under pressure therein bodies of the liquid solvent squeezed out of the fibers of the sheet under the compression; that the approach of the sheets to and withdrawal thereof from the compression stage of their travel shall in each case be gradual, whereby the exudation of the liquid solvent from the fibers of the sheet to be printed and its return thereto shall be gradual, thus both to insure its taking up the maximum quantity of color from the transfer sheet and avoid spurts or rushes of such solvent likely to malform the design being printed in some way; and that included in the complete apparatus is a sheet of protecting material, or "gray", immediately backing and movable along with the sheet to be printed whereby any color passing through such sheet to its reverse surface will not be deposited on said area backing such sheet and so mar any portion of the sheet that is to follow.

In the drawings,

Fig. 1 is a side elevation showing the two pressure means and the transfer sheet, sheet to be printed and gray extending between them;

Fig. 2 is a side elevation of one form of the apparatus, complete, with the said transfer sheet, sheet to be printed and gray extending between its said means;

Fig. 3 is a side elevation on a larger scale of fragments of the yielding aprons of said means, the transfer sheet and gray and showing them and the weft threads of the sheet to be printed (fabric), which appears in longitudinal section, undergoing gradually increasing pressure;

Fig. 4 is a diagrammatic fragmentary plan of the sheet to be printed (fabric), illustrating a cell therein;

Fig. 5 is a section on line 5—5, Fig. 4; and

Fig. 6 is a side elevation of the transfer sheet and gray with the sheet to be printed therebetween, in longitudinal section, under pressure.

Let 1 designate a suitable frame. 2 is a fixed horizontal bed therein, and 3 a vertically movable horizontal bed. To move bed 3 toward or from bed 2 there may be vertical shafts 4 fixed in the latter and threaded at 5 and rotary pairs of intergeared members 6 which in effect are nuts arranged to revolve

on and engaged with the threading of the shafts and journaled in the bed 3, the two pairs of members being in mesh with a driving pinion 7 on a vertical shaft 8 which may be driven from any motor 9 backward or forward. Each bed includes a way or track 10 so formed that the mid-portion thereof is parallel with that of the other such bed, but at both ends the ways gradually converge toward said mid-portions.

Each bed has journaled therein longitudinally spaced sprocket wheels 11 around which extends an endless flexible belt composed of blocks 12 linked together pivotally at 13 and preferably each having anti-friction rollers 14 which travel in contact with the ways 10. Around each such belt extends an endless apron 15 of flexible and elastically yielding impervious material, as rubber, and at one point in its circuit this apron may reach around idler rollers 16 and 17 journaled in the bed and one, as 17 of which may be adjustable to take up any slack in the apron; the means for adjustment is not shown, as not particularly material to the invention. Each block 12 has a flat acting face $12a$ so formed that when the portion of the belt including it and its neighbors is extended or straight, as when they are travelling along the mid-portion of the way 10, the faces $12a$ of these blocks will lie in a common plane and will present, also, so far as possible an uninterrupted surface.

The sheet a to be printed and the transfer sheet b are shown supplied from rolls a' and b' thereof journaled on a stand 18, and the gray c is shown supplied from a roll c' thereof journaled on frame 1 and may be rewound at c^2. After passing through the machine whereby the printing is effected and above described the transfer sheet goes to discard 19 and the fabric to winding-up means 20, where it may be wound up in a roll b^2 with a strip of paper d to separate its printed convolutions from each other; meanwhile it may pass over a drying, tentering or other apparatus, 21, for giving some after-treatment to the printed sheet.

The rotarily moving systems of the machine, to wit, the sprocket wheels, belts and aprons, may be driven in any way from a motor, as 22, acting through a shaft 23 geared at 24 with sprocket wheels of such systems.

The pressure means coactive to exert compression on the interposed transfer sheet and sheet to be printed and otherwise characterized as hereinbefore set forth are here the beds and each of the endless structures comprising a belt and an apron.

Adjustment to obtain proper pressure, according to the thickness of the sheets between the coactive pressure means and other conditions, having been effected, when the rotarily moving systems are driven the transfer sheet, sheet to be printed and gray will of course be passed through the machine. The fabric is assumed to have had previously applied thereto some liquid solvent, as water, of the color to be transferred which forms the design on the transfer sheet; for this purpose 25 may be taken as means, as a wetted absorbent roller, over which the fabric passes and by which it is wetted on its way to the machine. The result will be that under the pressure the solvent will be first squeezed from the fabric threads a^2 into the spaces or cells a^3 existing therebetween and while so entrapped will attack and dissolve the color on the transfer sheet and, the pressure being relaxed, the solvent, now carrying the color, will be reabsorbed by the threads, leaving them dyed and thus completing the transfer. This is a general statement of the operation.

My invention in its broadest aspect is not concerned with the specific instrumentalities set forth. It consists, as indicated, in pressure means coactive to exert compression on the interposed transfer sheet and sheet to be printed and having pressure areas continuously coactive to hold the sheets in part in surface to surface (as distinct from line to line) contact with each other and (at least) one of which means includes an endless and flexible pressure structure (here composed of the belt and apron) movable in its own circuit to advance the sheets between said means and edgewise of themselves. In the best form both of said coactive means have the endless and flexible pressure structures movable in their own circuits to advance the sheets.

Because at least one of the two sheets (transfer sheet and sheet to be printed) is backed by an elastic yielding medium (here apron 15) in effect forming the pressure surface of the corresponding pressure means accuracy and uniformity of the transferred impression result. This is largely because under the pressure the liquid is squeezed out of the fibers of the sheet to be printed into the adjacent voids or cells a^3, and the said medium (15) then coacts with the other sheet and the surrounding threads or mass of fibers to entrap the liquid while it dissolves the color on the transfer sheet preparatory to returning, colored, to the fibers when the pressure is relaxed; if both sheets are backed by such media the cells will be closed against possible escape of the liquid at either face of the fabric. But when, as here, at least one of the pressure means includes an endless travelling series of interlinked elements, as 12, some of which in a certain area of their travel present a plane surface to the other pressure means it is important that such medium be present and flexible and arranged to travel with said series of elements so that in the shifting of said elements to and from the positions in which their acting faces are in said plane their leading or following

edges will not wipe on the sheet opposed to them and cause a blur or spread of the color.

In any attempt to effect transfer printing by means of rollers a serious obstacle to speed exists in that the solvent squeezed out of the wetted sheet to be printed will issue back of the nip of the rollers in greater or less quantity instead of remaining in situ, which of course spoils the design transferred. By my invention I attain as good transfer effects as are possible by platen printing and yet accomplish this progressively and at much higher speed than is possible with the use of rollers because, besides including in the pressure means inter-linked elements having elastically yielding pressure surfaces, I provide for the gradual increase of the pressure up to the maximum (which maximum is here represented as between the line *x*—*x* in Fig. 1): As the sheets approach the zone or area of maximum pressure wherein the pressure surfaces are substantially parallel, one pressure structure moves in a path which is gradually convergent with respect to the other such means. The solvent squeezed out of the fibers, instead of rushing or spurting into the cells and thereby perhaps reaching relatively remote fibers, flows into the cells slowly. To prevent a too impetuous rush back to the fibers on release of the pressure, the construction in the best form is such, also, that one pressure structure moves in a path which is gradually divergent with respect to the other pressure means, or convergent with respect thereto toward the said zone. Herein lies an important feature of my invention in that I can attain good, sharp transfer without vagrant effects and yet carry on the operation rapidly.

Another important feature of my invention is the inclusion in the apparatus of the gray *c* having a leading free end (so that it may go to discard) and immediately backing and movable along with the sheet *a* to be printed. Without this, as soon as the wetted sheet *a* received color, and if such color penetrated the sheet, the color would be deposited on the pressure means backing such sheet and possibly remain to mar a portion of said sheet which is to follow; for instance, in the example, being deposited on the apron 15 backing sheet *a*, it would remain to produce a possible false print on the back thereof in the succeeding circuit or circuits of the apron.

The sheet of gray is preferably non-absorbent, by which I not only conserve the color but insure that the surface of the fabric next to the gray receives as much as possible of the color; where an absorbent gray is used the gray absorbs color that would otherwise be absorbed by the fabric and strands in the fabric fail sometimes to be colored at their portions which adjoin the gray.

Having thus fully described my invention what I claim is:

1. In a transfer apparatus, pressure means coactive to exert compression on the interposed transfer sheet and sheet to be printed and having pressure areas continuously coactive to hold the sheets in part in surface to surface contact with each other and one of which means includes an endless flexible pressure structure movable in its own circuit to advance the sheets between said means and edgewise of themselves and one of which means has its pressure surface elastically yielding.

2. In a transfer apparatus, pressure means coactive to exert compression on the interposed transfer sheet and sheet to be printed and having pressure areas continuously coactive to hold the sheets in part in surface to surface contact with each other and one of which means includes an endless flexible pressure structure movable in its own circuit to advance the sheets between said means and edgewise of themselves and one of which means has its pressure surface elastically yielding and impervious.

3. In a transfer apparatus, pressure means coactive to exert compression on the interposed transfer sheet and sheet to be printed and having pressure areas continuously coactive to hold the sheets in part in surface to surface contact with each other and one of which means includes an endless flexible pressure structure movable in its own circuit to advance the sheets between said means and edgewise of themselves and each of which means has its pressure surface elastically yielding.

4. In a transfer apparatus, pressure means coactive to exert compression on the interposed transfer sheet and sheet to be printed and having pressure areas continuously coactive to hold the sheets in part in surface to surface contact with each other and one of which means includes an endless flexible pressure structure movable in its own circuit to advance the sheets between said means and edgewise of themselves and each of which means has its pressure surface elastically yielding and impervious.

5. In a transfer apparatus, pressure means coactive to exert compression on the interposed transfer sheet and sheet to be printed and having pressure areas continuously coactive to hold the sheets in part in surface to surface contact with each other and each of which means includes an endless flexible pressure structure movable in its own circuit to advance the sheets between said means and edgewise of themselves and each of which has its pressure surface elastically yielding.

6. In a transfer apparatus, pressure means coactive to exert compression on the interposed transfer sheet and sheet to be printed and having pressure areas continuously coactive to hold the sheets in part in surface to surface contact with each other and each of

which means includes an endless flexible pressure structure movable in its own circuit to advance the sheets between said means and edgewise of themselves and each of which has its pressure surface elastically yielding and impervious.

7. In a transfer apparatus, pressure means coactive to exert compression on the interposed transfer sheet and sheet to be printed and having pressure areas continuously coactive to hold the sheets in part in surface to surface contact with each other and one of which means has its pressure surface elastically yielding and includes an endless flexible system of interlinked elements movable in its own circuit to advance the sheets between said means and edgewise of themselves.

8. In a transfer apparatus, pressure means coactive to exert compression on the interposed transfer sheet and sheet to be printed and having pressure areas continuously coactive to hold the sheets in part in surface to surface contact with each other and each of which means has its pressure surface elastically yielding and includes an endless flexible system of interlinked elements movable in its own circuit to advance the sheets between said means and edgewise of themselves.

9. In a transfer apparatus, pressure means coactive to exert compression on the interposed transfer sheet and sheet to be printed and having pressure areas continuously coactive to hold the sheets in part in surface to surface contact with each other and one of which means is endless and movable in its own circuit to advance the sheets between said means and edgewise of themselves and includes an endless flexible system of interlinked elements and an endless apron surrounding said system.

10. In a transfer apparatus, pressure means coactive to exert compression on the interposed transfer sheet and sheet to be printed and having pressure areas continuously coactive to hold the sheets in part in surface to surface contact with each other and one of which means is endless and movable in its own circuit to advance the sheets between said means and edgewise of themselves and includes an endless flexible system of interlinked elements and an endless elastically yielding apron surrounding said system.

11. In a transfer printing apparatus pressure means coactive to exert compression on the interposed transfer sheet and sheet to be printed and having pressure areas which in part are substantially parallel with each other and in part are substantially planiform and as to their planiform portions gradually converge toward their parallel portions and one of which means includes an endless flexible pressure structure movable in its own circuit to advance the sheets between said means and edgewise of themselves.

12. In a transfer apparatus, the combination of pressure means coactive to exert compression on the interposed transfer sheet and the wetted sheet to be printed and one of which is rotative in peripheral coaction with the other to advance the sheets between them and edgewise of themselves, and a sheet of gray having a leading free end and arranged between said means and immediately backing the sheet to be printed and advanceable edgewise therewith by said means.

13. In a transfer apparatus, the combination of pressure means coactive to exert compression on the interposed transfer sheet and the wetted sheet to be printed and one of which is rotative in peripheral coaction with the other to advance the sheets between them and edgewise of themselves, and a sheet of gray of impervious material having a leading free end and arranged between said means and immediately backing the sheet to be printed and advanceable edgewise therewith by said means.

In testimony whereof I affix my signature.

MAURICE PARTIOT.