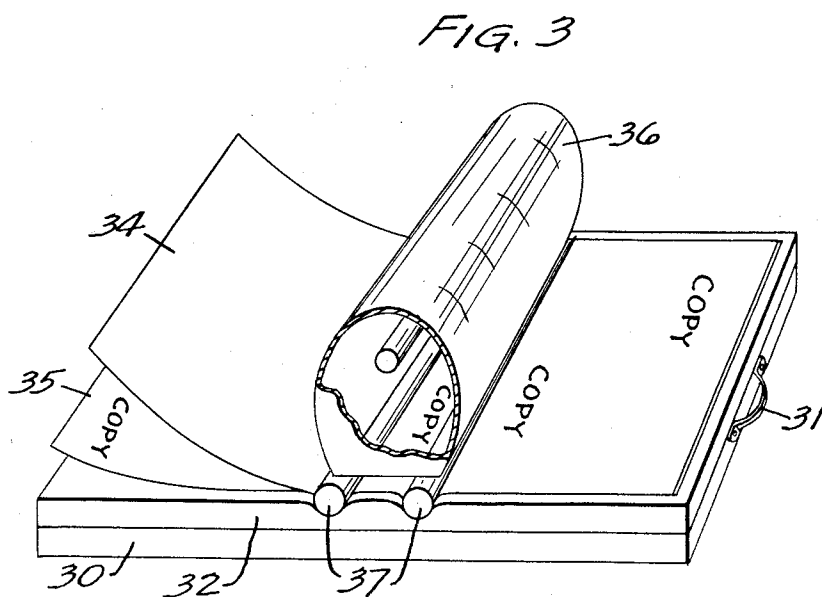
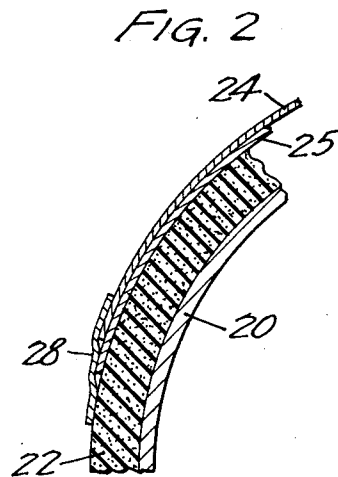
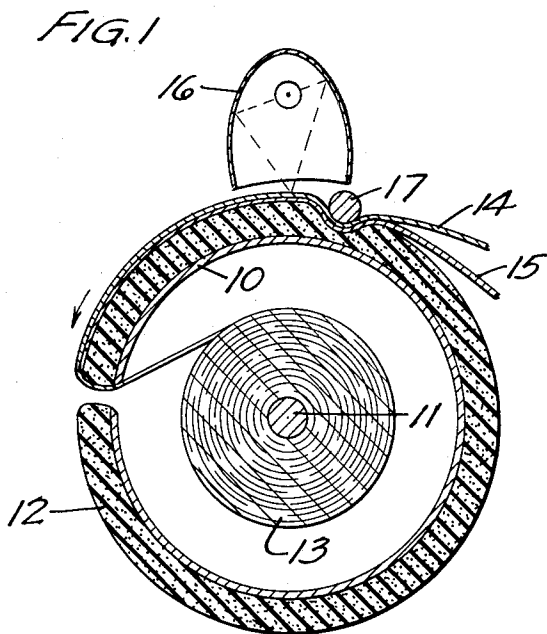


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THERMOPRINTING APPARATUS

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THERMOPRINTING APPARATUS

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This invention relates to thermoprinting apparatus useful in the reproduction of typewritten or printed copy on heat-sensitive copying-paper. The invention is particularly concerned with simplified means for placing the printed original and the copy-sheet in mutually heat-conductive pressure-contact and in position for irradiation.

Thermoprinting apparatus and methods have been described, e.g. in Miller Patents No. 2,740,895 and 2,740,896. The process there described involves placing a suitable heat-sensitive copying-paper in pressure-contact with a printed or other graphic original, and irradiating the printed surface with radiation which is selectively absorbed therein to produce a heat-pattern corresponding to the graphic subject matter and of an intensity sufficient to cause a visible change in the copy-paper. Suitable radiation is conveniently provided from a tubular lamp having a linear filament and housed within a reflector having a truncated elliptical cross-section. The lamp is located along an internal line of focus of the reflector, and the radiation is concentrated at the opposing external line of focus, the latter lying within the plane of the graphic original.

The amount of heat available for conversion of the heat-sensitive layer to a visibly distinct form in the process just described is limited both by the nature of the process and by the materials of which the sheets are made. It is therefore necessary to carefully conserve the heat liberated in order to obtain a sufficiently high temperature for actuation of the copy-paper. The two sheets must be held in close mutually heat-conductive pressure-contact during irradiation, so that the heat provided in the original will be made available to the heat-sensitive layer of the copy-paper. External heat loss must be minimized.

The present invention provides means for accomplishing these and other objectives in a simplified manner. Apparatus has been constructed, using the principles here provided, with which copies of typewritten letters and the like are readily produced by hand manipulation, the apparatus requiring but little space, being simple and convenient in operation and economical of manufacture.

The apparatus will now be described in connection with the accompanying drawing showing illustrative embodiments, and in which:

Figure 1 is a view in cross-section of a rotary form of the apparatus of this invention;

Figure 2 shows in cross-section a clamp detail of another form of rotary thermoprinting apparatus; and

Figure 3 is a view in perspective of a flat-bed model of the thermoprinting apparatus of this invention.

The apparatus of Figure 1 comprises a cylinder 10 mounted on an axle 11 and covered with a layer 12 of sponge rubber. A roll 13 of heat-sensitive copying-paper is suspended from the axle 11 within the drum 10. The strip is drawn from the drum through an axial slot in the drum and cover and against tension applied to the roll 13, by means not shown. The section 14 thus

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withdrawn is then laid over an original 15, such as a typewritten page, on the covered cylinder.

The assembly just described is rotated at constant speed in the direction indicated, the paper passing beneath a source of radiation 16 consisting of a lamp and reflector as hereinbefore described in connection with the apparatus of Miller Patent No. 2,740,895. A suitable smooth-surfaced bar 17 is pressed against the two-ply combination along a line closely adjacent the line of irradiation from the lamp assembly 16 and with sufficient force to compress the sponge rubber cover 12 to a substantial degree. The resiliency of the sponge surface serves to press the copy-paper 14 and the original 15 together and in intimate heat-conductive contact along the line of irradiation, as the line is swept across the surface. The sponge also serves to prevent loss of heat at that point. As a result, the desired heat pattern is established and a reproduction of the graphic original is obtained in the copy-paper.

The copy-paper 14 of Figure 1 is drawn from the roll 13 against tension applied thereto, the tension being sufficient to prevent further withdrawal of paper as the copying operation proceeds. Clamp means may also be provided at the roll or elsewhere for more firmly holding the copy-paper 14 during the copying process, although the tension on the roll is ordinarily sufficient for this purpose. An alternative means of fastening an original 25 and a sheet of heat-sensitive copy-paper 24 to the surface of a sponge rubber cover 22 on a cylinder 20 is shown in Figure 2 to consist of a strip 28 of pressure-sensitive adhesive tape applied along the leading edges of the original and the copy-paper and to the area of the compressible cover just in advance thereof. With this modification, single sheets of copy-paper are easily applied and utilized. Other effective clamp means may obviously be substituted for those here indicated.

The apparatus of Figure 3 consists simply of a flat base 30 covered with a sheet 32 of sponge rubber and capable of being drawn, by means of handle 31, beneath a stationary reflector and lamp assembly 36, shown with the end cover broken away for convenience in illustration, and a pair of pressure rollers 37. Alternatively, the radiation and pressure elements may be made movable and the base held stationary. A graphic original 35 and a sheet of heat-sensitive copying-paper 34 are placed in that order over the compressible upper surface of the support and beneath the rollers 37, being clamped to the covered base plate along the forward edge by means not shown. Drawing the base beneath the rollers and lamp assembly at constant speed provides intense brief irradiation of the two-ply combination along a line between the two rollers and at which the resiliency of the compressed sponge rubber cover provides the desired pressure contact between the two sheets. As indicated in the drawing, a copy of the graphic subject matter is thereby produced on the heat-sensitive copying-paper.

In a typical example of the device of Figure 3, a 1/4 inch thickness of sponge rubber was compressed to something less than one-half its original thickness beneath each of a pair of parallel rollers about one-half inch in diameter and about one inch apart, the focal line of the reflector falling on the surface along a line midway between the two rollers. Excellent copies were obtained by merely drawing the plate and paper assembly beneath the roller and lamp assembly by hand. Ease of operation is increased by providing guide-ways and friction-reducing bearings for the plate assembly, and more accurate and uniform exposure is obtained by mechanically driving the plate assembly—or, alternatively, the roller and lamp assembly—at constant speed, where such refinements are desired.

The twin roller compression system illustrated in con-

nection with Figure 3 is equally applicable to the rotary base structure of Figure 1. The rollers may be individually mounted but are more conveniently suspended in a spring-mounted framework as a unit, the pressure exerted by the rollers thereby being more readily regulated and equalized. Just sufficient pressure is applied to cause the original and copy-paper to be held together in heat-conductive pressure-contact by the resultant expansion of the compressed sponge rubber or equivalent resilient heat-insulative supporting layers. Rollers, as employed in the device of Figure 3, operate more smoothly than does the stationary bar of the modification shown in Figure 1 and without danger of tearing the copy-paper; but the stationary bar has proven adequate for many applications, is somewhat less expensive, and offers greater rigidity than is available with rollers of limited diameter, particularly where wide widths of copy are to be processed. It may be supported either from an adjustable spring mounting, or from a lever system permitting rapid raising and lowering of the bar where needed, or in other ways.

The apparatus described has been shown to be extremely simple in construction and operation. In addition it has been found to be surprisingly efficient, both in providing copy having improved resolution and contrast and in permitting reduction in exposure time or lamp wattage, as compared to previously available thermocopying apparatus.

Typewritten correspondence, printed leaflets, photographs, sketches and drawings, pencilled notes, and various other forms of graphic subject-matter on flexible paper or other sheet material are conveniently and quickly reproduced by means of the methods and apparatus hereinabove described; and are considered as coming within the meaning of the term "printed" page or sheet. There is involved the differential absorption of the radiant energy by the printed and unprinted areas of the original, the conversion of absorbed radiant energy to heat energy, and the resultant development of a heat-pattern corresponding to the graphic original and of an intensity sufficient to cause a visible change in the associated heat-sensitive copying-paper. It will therefore be appreciated that the type of graphic image and the type of radiation to be employed are, to some extent at least, interdependent. For example, where radiation high in infrared is employed, an original printed with an ink containing infra-red-absorptive pigments such as carbon black will yield a fully satisfactory copy.

The relative position of the copy-paper and the original is illustrated in the drawing in terms of the "front-printing" process, the radiation-transmitting heat-sensitive copying-paper being placed between the source of radiation and the printed surface of the original. Copy may also be obtained with the sheets in the reverse or "back-printing" position in which the heat-sensitive sheet is placed beneath the thin original, the printed surface of which faces the source of radiation. These processes are further described and explained in Clark et al. Patent No. 2,710,263, which also describes one typical form of heat-sensitive copying-paper. Others forms of heat-sensitive copying-paper, also useful in the apparatus of the present invention are described in Miller et al. Patents Nos. 2,663,654-7.

In using the apparatus as hereinbefore described and illustrated, it is sometimes found that the trailing edge of the copy-paper and original may spring upward as it passes under the pressure-bar or roller, with resultant incomplete copy, or edge fraying or folding, or other difficulty. This condition is readily eliminated by placing a retaining sheet of transparent flexible material, such as silk screen or tissue paper, over the composite with the trailing edge extended well past the trailing edge of the composite. For continuous operation, the retaining sheet may be arranged in the form of a continuous belt,

The thin flexible sheet permits full compression and expansion of the resilient sponge rubber compression pad.

What is claimed is as follows:

1. In a thermoprinting apparatus suitable for the reproduction of a printed page on a heat-sensitive copy-paper, the combination of: resilient compressible support means for supporting said page and said copy-paper as a two-ply composite in position for irradiation; compression means for locally uniformly pressing said composite against said support, and for thereby compressing said support, along a line across said composite; means for imparting relative motion between said support means and said compression means to sweep said line across the support surface; means for tautly holding said composite against said compressible support means during resilient recovery; and means for strongly and briefly uniformly irradiating the printed surface along a line closely adjacent the compression line at a position of substantial resilient recovery of the compressed support means.

2. In a thermoprinting apparatus suitable for the reproduction of a printed page on a heat-sensitive copy-paper, the combination of: resilient compressible support means for supporting said page and said copy-paper as a two-ply combination in position for irradiation; a pair of parallel closely spaced compression rollers for locally pressing said combination against said support, compressing said support, and permitting resilient expansion of said support therebetween; means for imparting uniform relative motion between said support means and said compression rollers to advance said rollers across said support; and means for strongly and briefly uniformly irradiating the printed surface along the line of said resilient expansion.

3. In a thermoprinting apparatus suitable for the reproduction of a printed page on a heat-sensitive copy-paper, the combination of: a forwardly movable base having a resiliently compressible porous sheet-supporting layer for supporting said printed page and said copy-paper as a two-ply composite in position for irradiation; a pair of parallel closely spaced compression rollers parallel to said sheet-supporting layer and capable of being pressed thereagainst for providing progressive local compression and recovery of said compressible layer and corresponding deflection and return of said composite during relative movement of said base and said pair of rollers; and means for strongly and briefly uniformly irradiating a printed page supported on said compressible layer along a line of resilient expansion of said compressible layer between said parallel rollers as said base is forwardly moved therebeneath.

4. In a thermoprinting apparatus suitable for the reproduction of a printed page on a heat-sensitive copy-paper, the combination of: an axially slotted rotatable drum support member having a resiliently compressible surface covering; means for retaining a supply of copy-paper within said drum in position for dispensing said copy-paper through the axial slot under tension; compression means for uniformly compressing said surface covering along an advancing paraxial line as the drum is rotated; and means for strongly and briefly uniformly irradiating a printed page on said surface along a line of resilient expansion of said covering adjacent said compression means.

5. The method of obtaining a reproduction of a printed page on a heat-sensitive copying-paper, comprising: fastening said page and said copying-paper as a two-ply composite upon a resilient compressible support; progressively uniformly locally pressing said composite against said support under pressure sufficient to compress said support; progressively permitting the compressed support to expand against the tautly held composite; and strongly and briefly irradiating the smoothly supported composite along an area of substantial resilient expansion of said compressed support.

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6. A flat bed thermoprinting apparatus suitable for the reproduction of a printed page on a heat-sensitive copy-paper, comprising: a rigid flat base having a resiliently compressible surface layer for planarly supporting a composite of said printed page and said copy-paper; a linear pressure member supported in a plane parallel to said base for locally pressing said composite against said compressible layer with accompanying localized linear compression of said layer; said base and said pressure member being capable of relative parallel planar movement causing progressive localized linear compression of said pressure member, deflection of said composite, and recovery to initial planar position of said pressure member and composite; means for tautly holding said composite against said compressible layer during said recovery; and means for strongly and briefly uniformly irradiating said printed page along the path of said linear recovery.

7. A flat bed thermoprinting apparatus suitable for the reproduction of a printed page on a heat-sensitive copy-paper, comprising: a rigid flat base having a resiliently compressible surface layer for planarly supporting a composite of said printed page and said copy-paper; a pair of parallel and closely adjacent rollers supported in a plane parallel to said base for locally pressing said composite against said compressible layer with accompanying localized linear compression of said layer; said base and said pair of rollers being capable of relative parallel planar movement causing progressive localized linear

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compression of said compressible layer and deflection of said composite beneath said rollers, and recovery at least to substantially initial planar position therebetween; and means for strongly and briefly uniformly irradiating said printed page between said rollers and along the path of said linear recovery.

8. The method of obtaining a reproduction of a printed page on a heat-sensitive copying-paper, comprising: placing said page and said copying-paper as a two-ply composite upon a resilient compressible support; progressively uniformly locally pressing said composite against said support under pressure sufficient to compress said support; holding said composite taut against said support while progressively permitting the compressed support to expand thereagainst; and strongly and briefly irradiating the smoothly supported composite along an area of substantial resilient expansion of said compressed support.

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