

April 15, 1958

J. J. CLANCY ET AL
ONE-USE TYPEWRITER RIBBONS

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2 Sheets-Sheet 1

e m

FIG. 1

e m

FIG. 2

e m

FIG. 3

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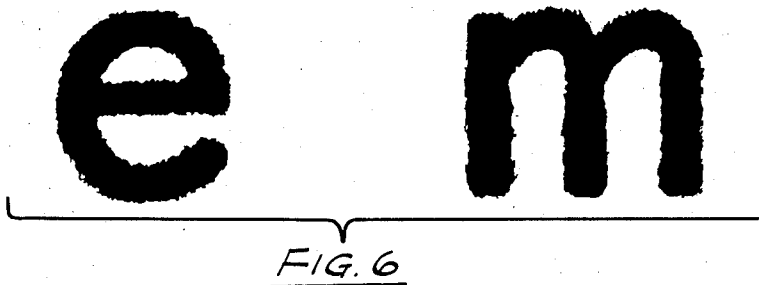
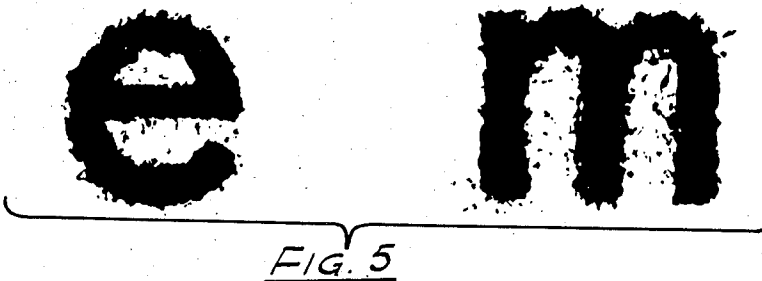
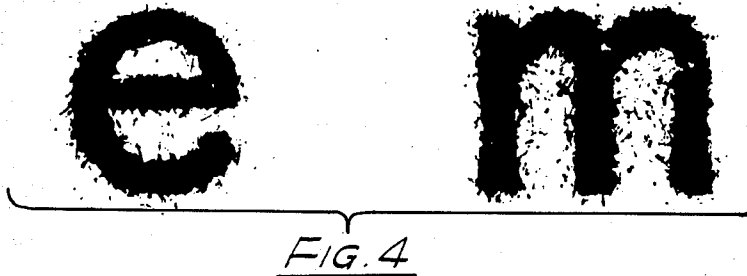
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ONE-USE TYPEWRITER RIBBONS

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3 Claims. (Cl. 197—172)

This invention relates to one-use typewriter ribbons.

The common fabric typewriter ribbon shows its cloth texture in the impressions made by the type faces of typewriters which use it. The use of finer weave in the fabric which constitutes the backing has overcome this defect only in part; the cloth texture is still evident. In an effort to eliminate this texture effect entirely, and to approach a letter-press printing effect, non-woven ribbons have been developed. These are commonly made of paper or of cellulose derivative such as cellulose acetate, coated on one side with an ink, and are one-use ribbons, i. e. designed for a single pass through the typewriter. These ribbons, of which the paper kinds are commonly known as carbon-paper ribbons, are extensively used in electric typewriters where the type face employed, plus the carbon-paper ribbon, provide a reasonably good approach to a letter-press printing effect in the typewritten product.

One-use typewriter ribbons also differ from fabric ribbons in that the former consist of a coated backing, while the latter consist of an impregnated backing, the coating or impregnating being done with appropriate inks. These inks necessarily differ in character. Those used for coating (commonly called one-use carbon-paper ribbon inks), are among other things too dry to be suitable for impregnating, while the impregnating inks are too fluid to provide a suitable coating for one-use ribbon backings. Both types of ink are, of course, designed and intended for use at ordinary room temperatures.

The purpose of the present invention is to provide a distinctly improved one-use typewriter ribbon. This ribbon closely approaches the ideal for producing a letter-press printing effect in the finished copy, inasmuch as the copy is excellent in sharpness and clearness of outline, uniform color density, lack of "splattering," regularity, and other desiderata of fine copy work. These statements are supported in detail by the accompanying drawings, and the description thereof which appears hereinafter.

The discussion which follows will therefore be directed to one-use typewriter ribbons in general, and to the improved one-use ribbon of this invention in particular. Fabric ribbons are not further considered herein, except when specifically mentioned as such.

Typing involves the transfer of ink from a one-use ribbon backing, inked on the reverse side, to copy paper by impact of the type face on the obverse side of the backing. This fact is clearly obvious from an examination of the one-use ribbon which after use shows where the ink has been removed from the ribbon. However, what is not obvious is the fact that such a transfer of ink is caused primarily by a shear or smudging action rather than by adhesion. This shear action is intensified by the wedge shape of the type face. Upon impact by the type face, the ribbon backing is deformed and tends to conform to the physical shape of the character. The deformed or stretched ribbon backing, in

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turn, also deforms the copy paper to conform to the same general physical shape. The ink transferred to the paper is deposited in a depressed area and is thus protected from smudging in handling the copy. The major portion of the ink is found on the slopes of the depressed area and only minor amounts at the bottom.

The performance of a one-use typewriter ribbon, in terms of sharpness of outline, uniform color density, lack of "splattering" around the letter, and clearness of outline when several carbon copies are made simultaneously, is in a large part dependent upon its ability to conform to the physical shape of the character to be printed. Conventional one-use typewriter ribbons do not deform sufficiently readily in the manner described above to give as "sharp" a write as would be desirable. In addition, when typing multiple copies with carbon sheets between, the individual letters on the first or original copy sheet show a "splatter" of ink around them. This is due to the inability of the paper or cellulose acetate or other conventional one-use ribbon backing to conform closely to the key which means that the impact force is distributed around an area larger than the character. This also results in a somewhat broader "write." It therefore is desirable to find a ribbon backing which possesses the ability to more nearly conform to the shape of the type face at the most suitable point of pressure application.

It is an object of this invention to make one-use typewriter ribbons which are capable of conforming to the shape or configuration of the type face. Other objects are to provide one-use typewriter ribbons capable of producing copy which has a well defined, sharp outline without any appreciable fuzziness or "splattering" of ink around or inside the configuration to be produced, which is of uniform color density, and which is pleasing to the eye in its normal size or when enlarged by any of the various known processes, whether making single copies or making a number of copies simultaneously. Still another object of this invention is to provide a one-use typewriter ribbon which will produce a good overall copy even when the striking pressure of the type face varies from key to key. These and other objects will become apparent in the following description and with reference to the accompanying drawings wherein:

Fig. 1 is an enlargement (approximately 20X) of the letters "e" and "m" typed on a single sheet of bond paper by a one-use typewriter ribbon having a paper backing;

Fig. 2 is an enlargement of the letters "e" and "m" typed on a single sheet of bond paper by a one-use typewriter ribbon having a cellulose acetate backing;

Fig. 3 is an enlargement of the letters "e" and "m" typed on a single sheet of bond paper by a one-use typewriter ribbon having a ribbon backing in accordance with the present invention;

Figs. 4, 5 and 6 are enlargements of the letters "e" and "m" typed on bond paper, having under it 4 additional sheets of the same bond paper with carbon interleaving, by one-use typewriter ribbons having ribbon backings of paper, cellulose acetate and the ribbon backing of this invention, respectively;

Fig. 7 is an enlarged cross-sectional representation of a small section of a one-use typewriter ribbon made in accordance with this invention; and

Fig. 8 is an enlarged cross-sectional representation of a small section of a one-use typewriter ribbon which is a modification of the ribbon of Fig. 7.

In the above description of the mechanism involved in making copy from a one-use typewriter ribbon, it was shown that the ribbon backing which holds the ink must be able to conform, i. e., actually become deformed, to the shape of the type face. However, it appears from further study of the behavior of the ribbon backing

that the plasticity required to permit the necessary amount of deformation is not by itself sufficient to give a superior copy. This leads to a possible explanation for the superior performance of the ribbon backing of this invention, namely, that the backing must also possess a certain amount of hysteresis or lag in returning to its shape or in partially returning. Because of such lag, the ribbon is entirely withdrawn from contact with the copy paper (when the type face is retracted) before it begins to give up the deformed shape imparted to it by the type face. If, on the other hand, the ribbon backing springs back into its original (flat) configuration as quickly as possible (being prevented from doing so only by the fact that it is deformed between the type face, on one side of it, and the indentation in the copy paper, on the other side), there will be splattering about the letters formed on the copy paper. Hence the ribbon must have a high degree of hysteresis.

We have found, in accordance with this invention that polyethylene film having the characteristics hereinafter set forth forms an ideal backing for one-use typewriter ribbons. Ribbons made from such film deform very readily to give sharp copy with no platter of ink around the individual configurations or letters. In addition, because of the relatively high deformability of polyethylene, a much greater degree of continuity (i. e., absence of light spots within the letter outline) of transferred ink is achieved. The sharpness and continuity achieved by the polyethylene ribbons of this invention are apparently attributable to the plasticity of the polyethylene, while the lack of splattering is apparently attributable both to inherent plasticity (to permit ready deformability) and to the hysteresis or lag in returning or partially returning to its original shape. The one-use ribbons of this invention therefore approach the ideal hereinbefore set forth, as will be evident in particular from the discussion below concerning the drawings.

The polyethylene film backing for the ribbon of this invention must be very thin, and preferably between one and two mils in thickness. The upper limit of thickness is about 3 mils. Film thicker than about 3 mils does not deform readily; it gives broader and dirtier "writes" which lack sharpness, clarity and uniformity. The lower limit of thickness is that of the thinnest film possible consistent with providing adequate strength in manufacture and use. We have used polyethylene films as thin as one-half mil; these give excellent results in typing but are difficult (but not impossible) to handle in the manufacturing step because of their lack of strength.

There is also a slight difference in thickness preference between polyethylenes made by the more conventional high-pressure technique, on the one hand, and those made by the low-pressure technique. The former are somewhat more flexible and can be employed in slightly greater thickness, in films of this invention, than can the latter. While about 3 mils is the upper limit of thickness, as already stated, we prefer, in the case of the low-pressure polyethylene films, to use films of not over about 2 mils in thickness.

The minimum average molecular weight of the polymer in the polyethylene film suitable for use in this invention is approximately 19,000. This figure is subject to variations depending upon molecular weight distribution, and other factors, but in any event an average molecular weight of less than about 17,000 results in a film of insufficient strength, resilience and hysteresis to satisfy the requirements of this present invention.

Orientation of the polyethylene film used in this invention is not objectionable, as long as it is not excessively great in one direction. In other words, there should be at least a significant amount of orientation in each direction. The polymer may be essentially straight chain, or more or less branched.

The ink used in coating the polyethylene film backing

of this invention is of the type normally used in preparing carbon papers and one-use carbon-paper base ribbons, and is referred to herein as a one-use carbon-paper ribbon ink. This type of ink is composed basically of a combination of waxes, oils, pigments and dyestuffs, and is of a rather grease-like, waxy, but solid consistency. Fabric ribbons, on the other hand, are impregnated with liquid inks which migrate into and are absorbed within the fabric. Both kinds of inks are readily transferred to the copy paper by the typewriting operation, at ordinary room temperatures. These are to be distinguished from paints and other marking compositions which require for their transfer special conditions such as elevated temperature to cause softening and flow, or relatively heavy and/or extended-time pressure to bring about effective transfer.

In its combination of the properties of deformability, hysteresis, and strength, the polyethylene film backing of this invention is unique among one-use typewriter ribbon backings, as far as we are aware. It is clearly superior to the commonly-used paper and cellulose acetate one-use ribbons, as will be shown below in connection with Figs. 1 through 6. In addition, we have tried many other types of films as ribbon backings, both the types suggested hitherto, and others which might be conceived of as one-use ribbon backings. In all instances, these other backings have proved inferior to the backing of this invention, in one or several respects.

Specifically, glassine, cellophane and paper backings have insufficient hysteresis and also are less extensible than polyethylene, i. e. they do not effectively deform about the type face. The consequences of these failings are illustrated below in connection with Figs. 1 and 4. "Mylar" polyester film (E. I. du Pont de Nemours & Co.) is still less satisfactory as a backing because it is even less effectively deformable or extensible. Backings of polyvinyl chloride, polyvinylidene chloride, vinyl chloride-acetate copolymers, or Pliofilm (chlorinated rubber) are also distinctly inferior to the polyethylene film of this invention. They are too rigid to deform effectively about the type face, unless plasticized. If plasticized sufficiently to achieve the desired deformability, however, they exhibit no, or substantially no, hysteresis, consequently there is no permanent, or relatively permanent, set; the yield point of the film has not been exceeded. Likewise with rubber as the backing, the yield point is not exceeded and there is no set whatsoever, although the deformability is excellent. Hence rubber is also distinctly inferior to the polyethylene film of this invention as a backing for one-use ribbons. Cellulose acetate, which is used in some commercial one-use ribbons, lacks effective deformability and also possesses insufficient hysteresis, as shown in detail below in connection with Figs. 2 and 5.

The performance of a one-use polyethylene typewriter ribbon made in accordance with this invention, may best be shown with reference to Figs. 1 through 6. A sectional view of a typical such ribbon appears in Fig. 7, wherein 10 designates the polyethylene film backing and 11 designates the above-described coating of one-use carbon-paper ribbon ink thereon.

The typing for all Figs. 1 through 6 was performed on an electric typewriter set in each case for the same degree of pressure. The letters "e" and "m" were chosen because they are made up of both straight and curved lines, and, in addition, the "e" has a small enclosed space. Thus, these two letters illustrate the basic features of the type faces found on an ordinary typewriter.

Figs. 1 through 3 (representing magnifications of 20X) were made by typing on single sheets of bond paper, using a commercial one-use paper ribbon (Fig. 1), a commercial one-use cellulose acetate ribbon (Fig. 2), and the polyethylene ribbon of this invention (Fig. 3). Figs. 4 through 6 (representing a like magnification) were typed on the same grade of bond paper as used in Figs. 1

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through 3, but with four additional sheets of the same bond paper, with carbon interleaving, under it. Thus, Figs. 4 through 6 were prepared in a way to simulate conditions which prevail when a number of carbon copies are made simultaneously with the original copy. As in the series of Figs. 1 through 3, Figs. 4 through 6 were typed using a commercial one-use paper ribbon (Fig. 4), a commercial one-use cellulose acetate ribbon (Fig. 5) and the polyethylene ribbon of this invention (Fig. 6).

Since the quality of a typewriter ribbon may be judged in terms of its ability to produce sharpness of outline, uniformity of color density and lack of splattering, Figs. 1 through 3 and 4 through 6 can now be examined with respect to these three parameters.

Fig. 1 indicates the presence of a marked amount of what might be termed irregularity around the edges of the outlines of the letters. Such irregularity is indicated by the presence of "spurs" of ink attached to the letter outline and by a general roughness of outline. In addition, the variation in thickness of the curved and also of the straight sections of the outline may be taken as a measurement of irregularity. This marked degree of irregularity in the letters of Fig. 1 typed with a commercial one-use paper ribbon in turn indicates a lack of sharpness of outline. Likewise the cellulose acetate ribbon of Fig. 2 shows irregularities which indicate a very noticeable lack of outline sharpness. Contrasted with these are the clear-cut outlines formed by the polyethylene ribbon of this invention (Fig. 3) which shows practically no irregularity or variation in outline thicknesses. In fact, when the original letters of which Fig. 3 is an enlargement, are examined under the microscope, it can be seen that the very slight roughness on the sides of these letters of Fig. 3 is actually the result of the fibers of the paper. This factor of fiber roughness was only a minor part of the irregularities observed for those letters forming Figs. 1 and 2.

Uniform color density, or more properly the lack of it, can be judged in terms of the amount of uninked or white spots left within the letter outlines. While those letters in Figs. 1 and 2 (especially in Fig. 1) show a number of such white spots there are none in the letters typed by means of the polyethylene ribbon of this invention (Fig. 3).

The sharpness of outline and the uniformity in color density may be considered to be measurements of the degree of plasticity or ability to deform about the type face. From a visual examination it appears that the paper and cellulose acetate ribbons used in preparing Figs. 1 and 2 possess about an equal degree of plasticity or deformability, and that both are far inferior in this characteristic to the polyethylene ribbon of this invention.

Finally, these letters should be examined to assess the amount of splattering caused. This can probably best be done by observing the number of small extraneous blots of ink which are completely or almost completely unattached to the body of the letter. From such observation it will be noted that the cellulose acetate ribbon (Fig. 2) shows a little splattering while the paper ribbon (Fig. 1) shows somewhat more. The polyethylene ribbon of this invention (Fig. 3) on the other hand shows no splattering. Since the lack of splattering is a measure of the degree of plasticity and hysteresis achieved, it is seen that while the polyethylene ribbon exhibits the required degree of deformability and hysteresis, the cellulose acetate and paper ribbons do not.

The letters in Figs. 4 through 6 may be analyzed in the same manner as that used for Figs. 1 through 3. In the simulation of conditions which obtain when a number of carbon copies are made simultaneously, the paper ribbon (Fig. 4) shows more irregularities and a marked increase in splattering over that shown for the one-copy typing (Fig. 1). A marked increase for the cellulose acetate ribbon is also shown. On the other hand, the letters typed with the polyethylene ribbon of

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this invention show only a very few irregularities, no loss in uniformity and no splattering. It is also interesting to note the increase in thickness of the letter outlines or bodies. The cellulose acetate ribbon shows the greatest increase while the paper ribbon shows somewhat more variation in letter thickness from one portion of the letter to another. The increase in thickness of the letters typed with the polyethylene ribbon (Fig. 6) remains negligible.

Thus, in respect to sharpness of outline, uniformity of color density and lack of splattering, the polyethylene ribbon of this invention is far superior to either the paper or cellulose acetate ribbon. The improved performance of the ribbon backing of this invention is even more marked under conditions simulating the making of several carbon copies simultaneously with the original copy. Since several carbon copies are generally made when typing, this fact is of great importance in the development of an improved ribbon backing.

In both cases (Figs. 3 and 6) the polyethylene ribbon exhibits a flexibility and plasticity which permits the ribbon backing, and hence the ink, to flow around the fibers of the copy paper, whereby the ink is deposited uniformly on the bottom of the indentation formed in the copy paper as well as on the slopes of the indented area. This accounts for the sharpness of outline, uniformity of color and uniformity of letter thickness under all conditions.

The necessity for a certain degree of hysteresis is shown by the absence of splattering around the letters typed with the polyethylene ribbon of this invention. An effective hysteresis is not present in the cellulose acetate backing. As stated previously herein, the same holds true of the polymeric films, other than polyethylene, there mentioned. Hence typewritten copy produced by the use of such backing films is fairly comparable in appearance to Figs. 2 and 5, and in no instances is it comparable in appearance to Figs. 3 and 6.

As already mentioned, a one-use carbon-paper ribbon ink is suitable for the coating 11 (Fig. 7). There are several formulas for such inks on the market, including the following which are suitable for the purposes of this invention:

Formula I

	Parts by weight
Extra heavy mineral oil.....	40
Oleic acid.....	5
Carnauba wax.....	37
Crystal violet.....	3
Carbon black.....	15
	100

Formula II

	Parts by weight
Extra heavy mineral oil.....	40
Carnauba wax.....	40
Carbon black.....	10
Iron blue.....	10
	100

The ingredients, in each example, are heated together and thoroughly mixed and ground on a conventional roller mill.

These inks which are suitable for the purposes of this invention are semi-plastic, more or less waxy or grease-like, and amorphous, and are substantially dry to the touch at room temperature. They do not form a film which is cohesive and self-supporting, but adhere adequately for type writing purposes to the polyethylene backing and also to the copy paper after the transfer thereto by impact of the type face. As already stated, such transfer takes place at normal room temperature.

There are many ways in which such an ink can be applied to the polyethylene backing, such as by using a reverse roll, printing from an engraved roll, spraying,

using a leveling rod, etc. The ink is generally applied at a temperature above room temperature where it is either fluid or at least plastic enough to spread readily. However, if the ink must be applied at a relatively high temperature to a polyethylene film of the thinnest kind, e. g. less than one mil in thickness, difficulty may be experienced in avoiding some curling or wrinkling of the film. Although this can be obviated by proper manipulation, a relatively simple procedure is to use a film of soft aluminum, not over about 1 mil in thickness, laminated to the polyethylene. This configuration is illustrated in Fig. 8, showing polyethylene film 10, ink 11, and aluminum film 12 on the other side of to the polyethylene film, but is not temperature sensitive film 10 from ink 11. The soft aluminum conforms closely and hence causes the polyethylene in the laminate to retain its shape during and after coating especially with hot ink on thin polyethylene film. As an example, a dead soft aluminum film 0.7 mil thick is laminated to a polyethylene film 0.6 mil thick. Such laminating is generally unnecessary if the polyethylene film is at least 1 mil thick. But in any event, the polyethylene backing alone, without lamination, gives better results in the typing operation than does laminated polyethylene film.

It will be seen from the above description of this invention that the mere indiscriminate substitution of one backing material for another in a typewriter ribbon will not assure improved results as indicated by sharpness of the copy, uniformity of color, and by the lack of splatter. By the use of a polyethylene film, having the characteristics herein defined, as a backing material for one-use typewriter ribbons in the manner herein set forth, the desired marked improvements in that type of ribbon are attained.

This application is a continuation-in-part of our co-pending application Serial No. 526,507 filed August 4, 1955, now abandoned.

We claim:

1. A one-use typewriter ribbon comprising a backing and a coating of ink thereon, said backing being a thin polyethylene film having a thickness of about $\frac{1}{2}$ to 3 mils, said polyethylene having an average molecular weight of at least 17,000, said film having significant orientation in both directions, said ink being of solid consistency and capable of being transferred at normal room temperature to copy paper by the impact of the type faces of the typewriter.

2. A one-use typewriter ribbon in accordance with claim 1, further characterized in that said polyethylene film bears a film of soft aluminum laminated thereto, said aluminum film having a maximum thickness of about 1 mil and being adhered to the side of said film opposite that on which said ink is applied, said polyethylene film being less than 1 mil in thickness.

3. A one-use typewriter ribbon consisting essentially of a backing of polyethylene film and a coating of ink thereon, said film having a thickness of about $\frac{1}{2}$ to 3 mils, said polyethylene having an average molecular weight of at least about 19,000, said film having significant orientation in both directions, said ink being of solid consistency and capable of being transferred at normal room temperature to copy paper by the impact of the type faces of the typewriter.

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