March 29, 1955 R. LANT 2,705,259

METHOD FOR PRODUCING COPYING STENCILS

Filed March 4, 1952 2 Sheets-Sheet 1

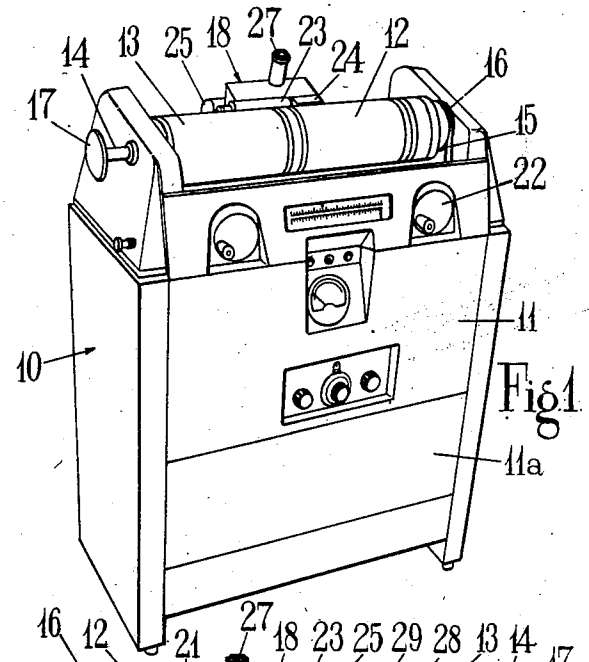


Fig 1

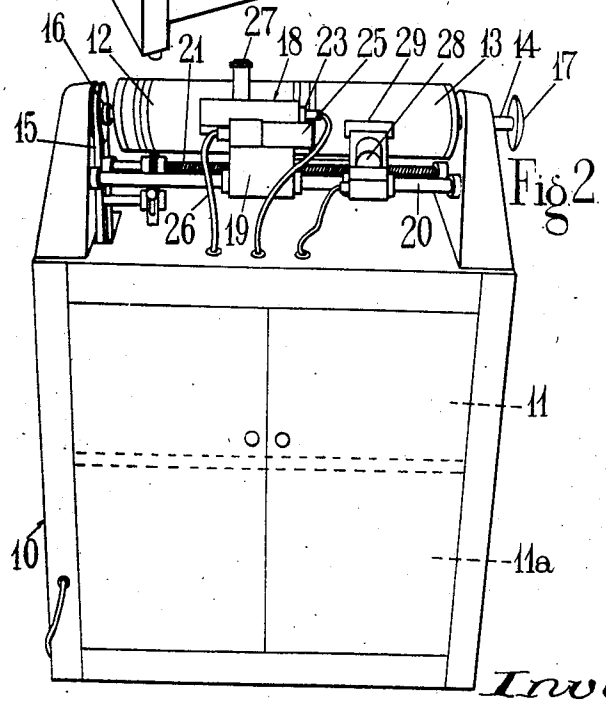


Fig 2

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METHOD FOR PRODUCING COPYING STENCILS

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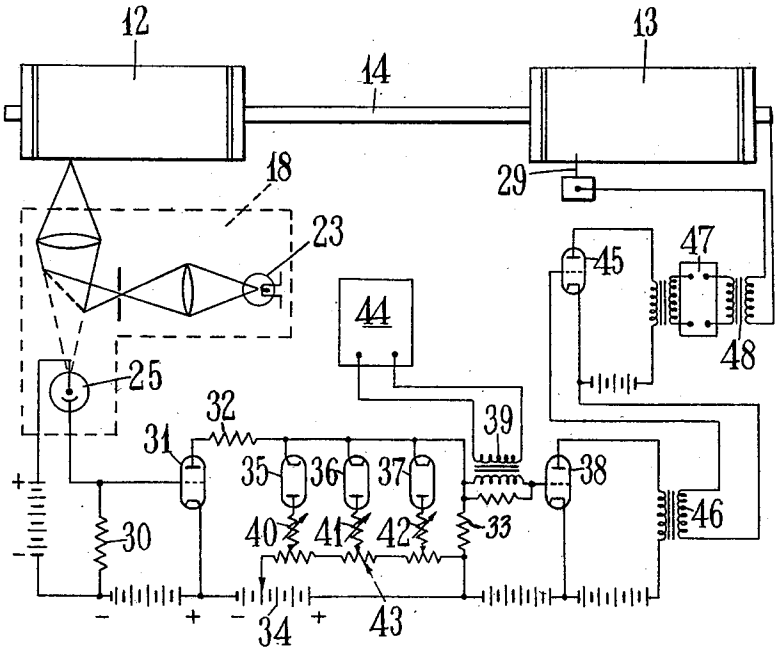


Fig. 3

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METHOD FOR PRODUCING COPYING STENCILS

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Claims priority, application Great Britain March 8, 1951

1 Claim. (Cl. 178—6.6)

This invention relates to a method for producing copying stencils, in particular to stencils for use with duplicating machines.

It has been previously proposed to produce from an original, copying stencils for use in duplicating machines by utilising current impulses originated on scanning the said original in a picture transmitting apparatus to control a spark which is caused to bridge a gap through which the stencil sheet is moved in synchronism with the original. The spark when produced perforates the sheet in its passage across the gap thereby forming a copying stencil which when used with a duplicating machine produces copies of typescript and other pictorial matter in a pattern comprising either black or white or other extreme shades depending on the colour of ink and paper used. The disadvantage of such a proposed method is that the system is limited to the producing of stencils reproductions from which give only these extreme tone values.

In a further previously proposed system both electrodes of the spark gap are mounted at the same side of a heat sensitive recording paper such that when a spark is passed the surface of the paper is burned but not perforated, and a copy of the transmitted picture is formed on the surface of the paper. It has been proposed to vary the intensity of the spark in sympathy with the tone values of a photograph or other pictorial matter used as the original. Should the original contain a variety of tone values between black and white, a copy is obtained on the surface of the recording paper representative of the variety of tones included in the original. The record thus obtained is of course unsuitable for use as a copying stencil.

Further proposals have been made for tone recording by spark on the surface, with one electrode sliding on the surface, the other electrode being formed by the metal cylinder.

In the above-mentioned method of producing a duplicating stencil by means of a spark discharge therethrough the effect of the spark on the stencil has to be such that the coating of the stencil, applied to a fibrous base such as Yoshino paper (which coating is impervious to ink), is destroyed to an extent such that black duplicating ink, passing through the affected area, gives a black image of this area on duplicating paper. If the energy passing through the stencil is too great, the fibre of the base paper is destroyed as well, making the stencil useless and, if the energy is insufficient too much of the impervious coating remains and a full black copy is not obtained. This is also considered unsatisfactory and thus a recording energy is selected which is insufficient to damage the fibre but still sufficient to let enough ink pass for yielding black copies. The correct amount of energy is made to pass the stencil between the two electrodes by adjusting the energy delivered by the output stage of the amplifier whilst no signal is being received from the photocell, simulating the scanning of a black area on the original. On the other hand it is necessary to suppress the energy output whilst scanning a white area on the original so that the stencil remains impervious to ink in the corresponding areas.

This is done by passing the photo-current generated by the light reflected from the original on to a photosensitive cell, through a load resistance and by amplifying the voltage developed across the load resistance in as many stages as are necessary for sufficiently biassing the output stage. In other words the working of the amplifier is such that the spark gap is supplied with full energy or none at all.

The object of the present invention is to provide a method for producing copying stencils, primarily for use in duplicating machines, from which copies may be obtained which may exhibit a continuous graduation of tone values, and which give a reproduction having tone values corresponding to those occurring in the originals from which the stencils are made.

The invention consists in a method of perforating a suitable stencil sheet to form a facsimile of an original in sheet form comprising scanning the original by a light spot in conjunction with a photosensitive cell, scanning said stencil sheet in synchronism with the scanning of the original by causing relative movement between the stencil sheet and at least one of the electrodes of a pair of electrodes forming a spark gap, the said stencil sheet being situated between the electrodes, and passing electric current through the stencil sheet in the form of sparks, said current being caused to vary in intensity in substantially linear relationship to the density of the part of the original being scanned.

In view of the fact that the light received by the photosensitive cell varies in intensity inversely as the antilogarithm of the density of the original, it is essential for this non-linear condition to be corrected, if the energy of the spark shall vary substantially in linear relationship with the density of the original. This can conveniently be effected in a suitable D. C. stage or stages of an amplifier feeding the spark gap, by including means for obtaining the necessary logarithmic reduction of the signal from the photosensitive cell.

The invention still further consists in stencils produced by the method as set forth in the penultimate preceding paragraph.

The copying stencils produced in accordance with the invention may be inherently opaque to light and be rendered transparent by the said method so as to be capable of being used as a transparency in photo mechanical printing processes.

It has been found that if a stencil of the kind previously described is subjected to less energy than that which is required for obtaining a black copy on the duplicator, a grey copy can be obtained, the grey on the copy being the lighter the less the current passed through the recording needle and the various shades of grey obtainable on copies simulate tones of a photographic wedge. The result is quite surprising and does not lend itself readily to an explanation because it apparently is not brought about, as one would expect, by the change of diameter of the perforations caused by the spark discharges increasing with the energy or current passing, but rather by the number of individual perforations increasing per unit area with increasing energy applied.

One might say therefore that in stencils produced in accordance with the invention with energy graded from white to full black, the spark discharge in conjunction with the stencil cuts its own tone screen, which is characterised by the number of perforations per unit area. As to the energy applied and density of copy obtainable, it can be said, as a general rule, that the density of the print stands in linear relationship to the current passed through the stencil, under otherwise similar conditions regarding duplicator, ink, duplicating paper, speed of printing and the like.

In order to correlate the tone value of the copy taken from the stencil in a duplicator with the corresponding tone value on a full tone original (photograph) it should be understood that the photo-current rises linearly with the amount of light received by the photosensitive cell. Thus, for example, if a photographic density wedge is scanned, the photo-current increases inversely linearly with the opacity of the various steps of the wedge, whereas, to produce a stencil of the required character the signal received by the output stage should vary in linear relationship with the density of the original. Therefore the amplifier must include some means for obtaining approximately the necessary logarithmic reduction of the signal from the photosensitive cell before it modulates the output current.

water so as to render the technical application of water possible. Therefore, it is of no consequence which hydroxides or salts are employed provided that they are sufficiently water-soluble and neutral, i. e. they must not form stable addition products with the nitrogen compounds to be separated and that they do not undergo reaction with the nitrogen compounds. Especially suitable salts are, for instance, common salt, sodium sulphate, sodium carbonate, sodium phosphate, sodium acetate, sodium formate as well as the corresponding potassium salts and alkali hydroxides, such as sodium and potassium hydroxide. Further substances which may be employed, are described, for instance, in British specification No. 475,818. The said salt solution may contain according to the special requirements only small amounts of the salt or quantities up to saturation. On using alkali hydroxides, solutions containing from about 5% to about 40% of the hydroxide are preferred.

Which of the nitrogen compounds is preferably absorbed depends on the nature of the absorbent applied. Thus, the invention permits of adapting the process to the prevailing conditions of the various absorbents in the single steps of the reaction. On the other hand, it is possible to apply the absorbents in combination in the same step as far as they agree as to their separating activity. For instance, the weak acids may be employed in combination with neutral solvents boiling not substantially lower than the weak acid applied and being indifferent to the weak acid as well as to the nitrogen compounds and yielding homogeneous mixtures with the weak acid. Suitable solvents are for instance o-dichlorobenzene, 1.2.4-trichlorobenzene, nitrobenzene, tetralin, dekalin, higher boiling aliphatic or aromatic hydrocarbons as far as they are still liquid under the reaction conditions applied, as well as higher boiling ethers, alcohols, ketones and polyalcohols.

The application of mixtures of the weak acids with the organic solvents is especially advantageous in the separation of ammonia from mixtures containing methyl amines and in the separation of a mixture consisting of mono- and dimethylamine. Furthermore, it is possible in the separation of trimethylamine from methylamine mixtures being free of ammonia to increase the separating activity of the weak acids by addition of water. Of course, water must not be added in quantities exceeding saturation at the temperatures employed.

The process according to the invention may be advantageously carried out by a continuous method by feeding the reaction mixture, if desired under pressure, in a reaction tower counter-currently to the flow of the absorbent. By appropriately adjusting the flow velocity and the temperature one or more nitrogen compounds are selectively dissolved in the weak acids or in the said other absorbents applied whereas the nitrogen compounds not absorbed escape as vapours at the top of the reaction tower. The absorbed compounds are expelled from the absorbent as described above. By repeating the process once or several times each of the components contained in the starting mixture may be obtained in pure form.

The process herein described is substantially different from that disclosed in German Patent 615,527. German Patent 615,527 comprises the separation of trimethylamine and ammonia by treatment with acids in quantities insufficient for neutralization. The resultant salts cannot be decomposed again by merely heating or by reducing the pressure.

The invention is further illustrated by the following examples, without being restricted thereto.

Example 1

A mixture of 62.5% by volume of ammonia and 37.5% by volume of trimethylamine is passed through a liquid mixture of 25% by weight of phenol and 75% by weight of o-dichlorobenzene. At the beginning the mixture is completely absorbed. After saturation of the absorbent a mixture of 90% by volume of ammonia and 10% by volume of trimethylamine escapes. The mixture of ammonia and trimethylamine dissolved in the absorbent is expelled again by heating to 170° C. The mixture consists of 33% by volume of ammonia and 67% by volume of trimethylamine. By repeating the process several times, each of the two components is obtained in pure form.

Example 2

A mixture of ammonia and dimethylamine is introduced into a molten mixture of α- and β-naphthol, the proportion of the mixtures being 1:1. After saturation of the naphthol melt at about 90° C. with the bases a gas mixture consisting of 68% by volume of ammonia and 32% by volume of dimethylamine escapes. By repeating the process several times, each of the two components is obtained in pure form.

Example 3

400 parts by weight of a solvent mixture consisting of 25% by weight of phenol and 75% by weight of o-dichlorobenzene is saturated with a mixture consisting of 78% by volume of trimethylamine and 22% by volume of ammonia. 108 parts by weight of the mixture are totally absorbed. Thereupon pure trimethylamine is introduced into the saturated solution through a glass frit. The escaping gas mixture consists of 50% by volume each of ammonia and trimethylamine. As soon as the content of ammonia in the escaping gas decreases feeding of pure trimethylamine is stopped. By heating the solution 112 parts by weight of a 96.5% trimethylamine are obtained.

Example 4

M-cresol and a gas mixture of approximately equal parts by volume of ammonia, dimethylamine, and trimethylamine are contacted in countercurrent in an absorption tower packed with Raschig rings, said absorption tower having a length of 2.50 m. and a diameter of 3 cm. 45 liters of the aforesaid mixture and 120 grams of m-cresol are charged each hour. The gas escaping at the top of the tower consists of 99% ammonia whereas the mixture of methylamines expelled from the absorbent is almost free from ammonia.

Example 5

The mixture of dimethylamine and trimethylamine set free on heating the sump obtained according to Example 4 is contacted with m-cresol in an absorption tower as indicated in Example 4. About 48 liters of the mixture of the methylamines and 90 grams of m-cresol are charged each hour. 98% trimethylamine escapes at the top of the reaction tower whereas a 90% dimethylamine is obtained by heating the sump solution.

Example 6

A mixture consisting of 55% by volume of ammonia, 15% by volume each of mono-, di-, and trimethylamine is contacted in countercurrent with a technical cresol mixture (30 grams per hour) in an absorption tower packed with Raschig rings, said absorption tower having a diameter of 25 mm. and a height of 2.50 m.; the throughput of said mixture amounts to 30 liters per hour. The non-absorbed gas contains 100% of the amount of ammonia charged and 95% of the trimethylamine charged and is free from mono- and dimethylamine.

The mixture absorbed by the cresol and containing besides small amounts of trimethylamine, the whole mono- and dimethylamine is contacted after expelling from the solvent with a mixture consisting of 1 part by weight of phenol and 3 parts by weight of o-dichlorobenzene in the same reaction tower and in similar manner.

100% monomethylamine escapes at the top of the reaction tower whereas 92% dimethylamine is obtained from the sump solution.

Example 7

A mixture of 49% by volume of ammonia and 17% by volume each of mono-, di-, and trimethylamine at a rate of 29 liters per hour is contacted, in countercurrent, at room temperature with a caustic soda solution of 10% strength in an absorption tower packed with Raschig rings and having a height of 2.50 m. and a diameter of 25 mm. The gas mixture is fed at a point in the middle of the tower, the sump of the absorption tower is heated to 45° C. When charging 70 cm.³ of caustic soda solution per hour 100% trimethylamine is taken off from the top of the tower. The dissolved nitrogen compounds are practically free from trimethylamine.

The dissolved mixture of nitrogen compounds is expelled by heating and contacted in a similarly constructed tower with a technical cresol mixture of such an amount that the mono- and dimethylamine contained in the mixture are dissolved whereas pure ammonia escapes at the top of the tower.

naturally be carried out by plotting the output current of the amplifier against the density of the original, to provide the required relationship between the density of the original and the current passing through the stencil sheet.

The oscillator represented by the unit **44** and which can be one of many of the well known types is connected by way of the transformer **39** to the grid of the valve **38**, whereby the oscillations become amplitude modulated by the signal owing to the method of operation of the latter across its anode bend. The modulated signal is applied to the amplifying valve **45** by the transformer **46**, the further amplified signal passing by way of the output stage **47** to the output transformer **48**, in the secondary circuit of which is included the spark gap, which is constituted by the recording needle **29** and the recording drum **13**.

In the example given the drums are caused to rotate in synchronism by the common shaft **14**, but if desired, the transmitting and recording drums can be situated remote from one another and be driven by separate motors run in synchronism in a known manner, the signals produced by the photosensitive cell being transmitted to the recording apparatus by wire or wireless. By this means the stencil can be used to record a picture or other matter at a distance and subsequently be used in a duplicating machine to produce a number of copies of the original.

It is known that stencil sheets suitable for recording with a spark must be fairly heavily loaded with finely divided conductors such as metal powder, graphite or carbon black. Any of these additions makes the stencil where the coating has not been perforated by a spark impervious to light. It has been found, for example, that a full tone reproduction made on a stencil sheet in accordance with the present invention can replace an ordinary film transparency in the various photo mechanical printing processes, whereby the otherwise necessary step of converting a full tone original into a half-tone transparency in a photographic camera is eliminated.

The stencil produced in accordance with the invention can be used for a similar purpose to stencils produced by other means, for example, in the printing of designs on fabrics or wall papers by means of a liquid or semi-liquid medium. Furthermore, the stencil may be used for making a copy in litho transfer ink on a litho transfer paper in the production of litho copies of the original. Also the stencil may be laid in contact with a hectograph surface (gelatine-glycerine compound) and this surface inked up through the stencil with a suitable hectograph ink, from which copies of the original can be made.

It is to be understood that the foregoing applications of the stencil are given as examples only and are not to be taken as limiting the use of the stencil thereto, for generally speaking the stencil is suitable for use in substitution of known stencils and known transparencies wherever its form of construction renders it suitable.

Instead of the photosensitive cell and recording needle being moved transversely in relation to the transmitting and recording drums, they may be fixed and the drums moved transversely in relation thereto and other details for carrying the invention into effect may be varied without departing from the scope of the invention.

I claim:

Method of perforating a suitable stencil sheet to form a facsimile of an original in sheet form comprising scanning the original by a light spot in conjunction with a photosensitive cell, scanning said stencil sheet in synchronism with the scanning of the original by causing relative movement between the stencil sheet and at least one of the electrodes of a pair of electrodes forming a spark gap, the said stencil sheet being situated between the electrodes, and passing electric current through the stencil sheet in the form of sparks, said current being caused to vary in intensity in substantially linear relationship to the density of the part of the original being scanned and varying the number of sparks per unit area in proportion to the tone values of the scanned original.

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