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K. G. ZEUTHEN ETAL

3,396,234

APPARATUS FOR PERFORATING A LAYER IN A MASTER

Filed Feb. 1, 1965

2 Sheets-Sheet 1

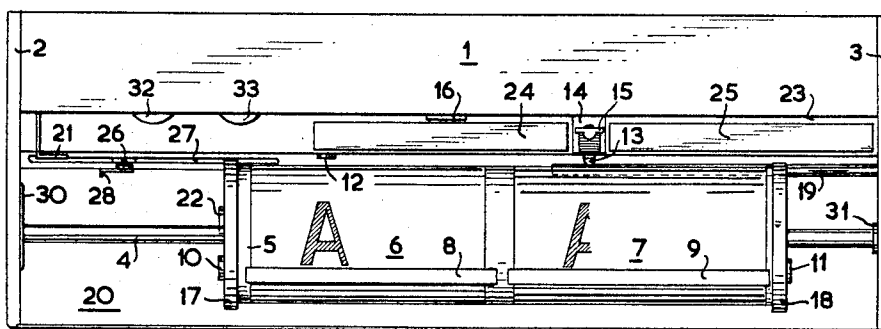


FIG. 1

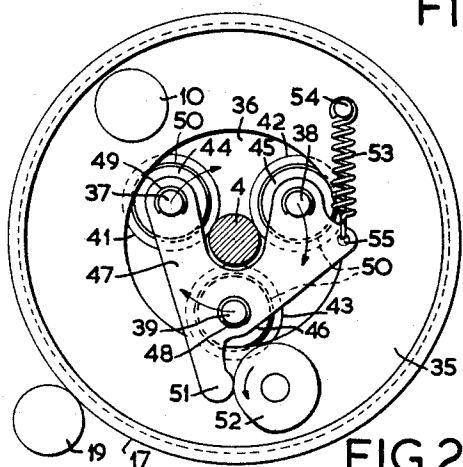


FIG. 2

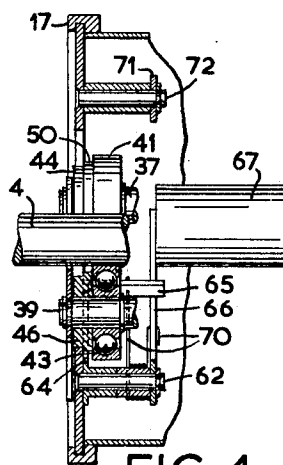


FIG. 4

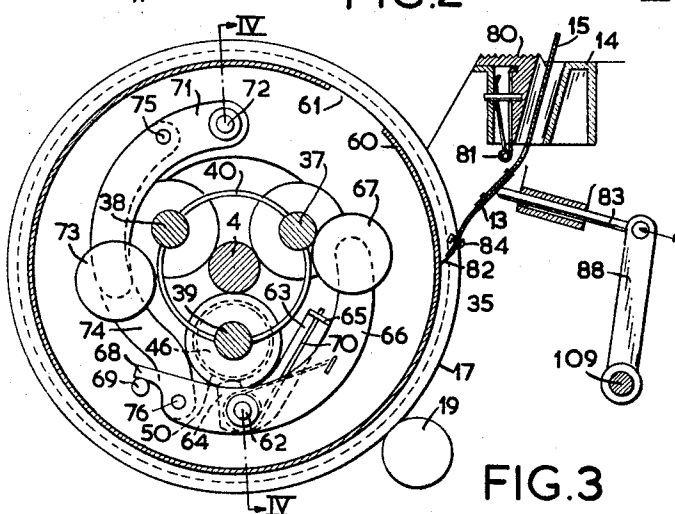


FIG. 3

INVENTORS

Karl G. Zeuthen
Svend E. Larsson

BY *Stevens, Davis, Miller & Mosher*

ATTORNEYS

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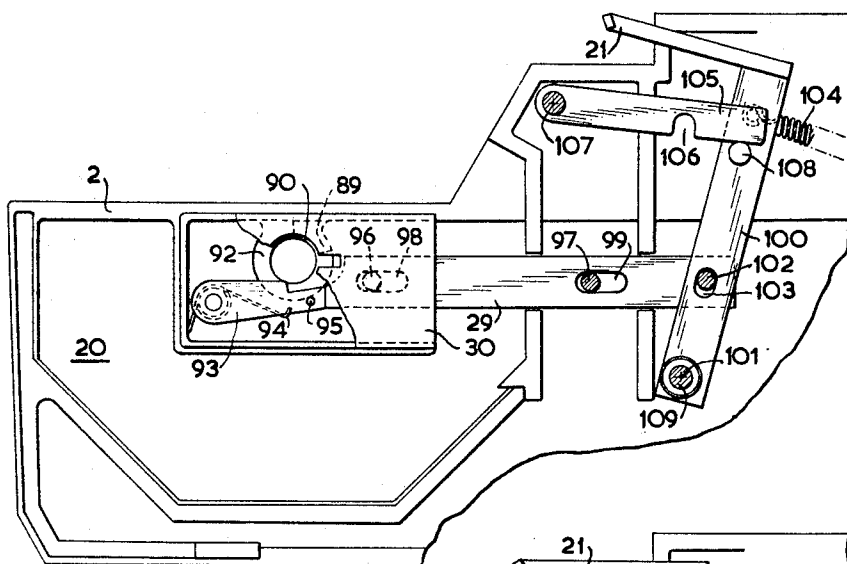


FIG. 5

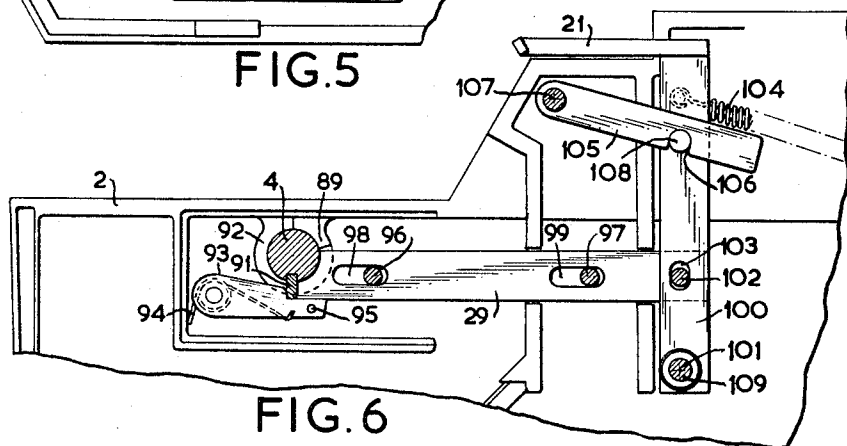


FIG. 6

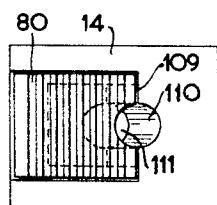


FIG. 7

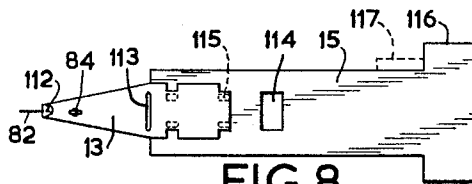


FIG. 8

INVENTORS

Karl G. Zeuthen
Svend E. Larsson

BY *Stevens, Davis, Miller & Mosher*

ATTORNEYS

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3,396,234

APPARATUS FOR PERFORATING A LAYER IN A MASTER

Karl G. Zeuthen, Gentofte, and Svend E. Larsson, Copenhagen, Denmark, assignors to Zeuthen & Aagaard A/S., Glostrup, Denmark, a company of Denmark

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20 Claims. (Cl. 178—6.6)

ABSTRACT OF THE DISCLOSURE

An apparatus for perforating a master copy from an original and comprising a drum rotatably mounted on a dismountable fixed shaft. The curved surface of the drum includes means for mounting the master copy and original thereon. A fixed optical system, including a light source, a photosensitive element and amplifier, is positioned to scan the original as the drum is rotated. Fixed perforating means responsive to the output of the optical system perforates the master copy. Driving means engage the periphery of the drum to both rotate it and move it axially as it rotates.

The invention relates to an apparatus for perforating a layer in a master and comprising a rotatably mounted drum on the curved surface of which an original and a master, respectively can be mounted beside each other in the longitudinal directional of the drum, an optical system including a light source and a photosensitive element for scanning the original during the rotation of the drum, an amplifier for the signals produced by the scanning, and a perforating member, e.g., a perforation electrode, which under the influence of the amplified signals perforates a layer in the master, e.g., by electrical discharges, in accordance with the scanning of the original.

Such an apparatus is used for producing on the basis of an original, e.g., printed matter, a picture, a drawing, or something else, a master in which a layer is perforated in accordance with the original. Such a master may in a duplicating machine, an offset printing machine, or some similar multiplying apparatus be utilized for producing a desired number of copies of the original. The apparatus can furthermore be used in connection with the production of single copies. The perforation of a layer in the master may, e.g., also be performed thermally or mechanically or may be performed by a chemical process.

Known apparatuses of the type mentioned above, e.g., apparatuses for the perforation of electrostencils for use in connection with duplicating machines, may be so constructed that the drum on which original and stencil are secured is mounted in a fixed position in the machine and is arranged for being moved only around its longitudinal axis. In order to scan the original and in accordance herewith perforate the stencil the optical system, which performs the scanning, and the perforation electrode, which performs the perforation of the stencil, must during the rotation of the drum be moved in the axial direction of the drum. In the known apparatuses, the optical system and the perforation electrode are during the rotation of the drum advanced by means of suitable control members (e.g., a threaded spindle), which advance these components parallel to the axis of the drum. Due to the rotation of the drum and the simultaneous axial movement of the optical system and the perforation electrode the original will be scanned along a helix, and the stencil will be perforated in conformity herewith. The speed, at which the optical system and the perforation electrode are advanced in the axial direction may be adjustable, so that the pitch of the helical scanning may be

2

varied. A low speed of advance for the optical system will give a long scanning time, but at the same time ensures a better reproduction of details.

In the apparatuses mentioned above, the optical system comprises a light source, a system of lenses, and a photosensitive element. From this photosensitive element, which may, e.g., be a photocell, a photomultiplier tube, or a photoresistance, signals are derived corresponding to the momentary light value in the helical path that is being scanned on the original. The signals from the photosensitive element are fed to an amplifier which is built into the apparatus and which under the control of these signals supplies the supply potential to the perforation electrode, so that the stencil is perforated in accordance with the scanning of the original.

Due to the design of the known apparatuses mentioned above, in which the optical system and the perforation electrode are moved in the axial direction of the drum, it is necessary as connection leads between the amplifier and the optical system and the perforation electrode, respectively, to use leads of comparatively great length. These leads should furthermore be flexible and placed in such a way that they are not subjected to detrimental stresses during their backward and forward movements along the guiding members of the optical system and the perforation electrode. It is furthermore necessary that particularly the signal leads from the photosensitive element of the optical system to the amplifier are screened leads, as otherwise disturbances may occur in the comparatively weak signals from this photosensitive element. As these screened leads from the photosensitive element to the amplifier, as mentioned above, must necessarily have a considerable length, and as the screened leads unavoidably have a certain capacity per length unit, the total capacity in these leads will often be of such an order of magnitude that undesirable changes of the signals transmitted to the amplifier occur, and as a consequence hereof a limit of the speed at which an original can be scanned, may occur.

The perforation of the stencil, which, e.g., by means of electrical discharges is performed by the perforation electrode, causes the occurrence of certain waste products in the form of interalia charred particles from the stencil, and these waste products must be prevented from penetrating into the various components of the apparatus. Apparatuses of the type referred to are therefore normally provided with a suction arrangement which removes these waste products. As the perforation electrodes in the known apparatuses are displaced in the axial direction of the drum, it is necessary that the suction arrangement is, e.g., by means of a flexible hose or the like, moved together with the perforation electrode. This may give rise to considerable constructive difficulties. A stationary suction arrangement covering the full length of travel of the perforation electrode will necessitate a very large suction capacity.

It is an object of the invention by basically modifying the design of known apparatuses to attain an improved construction which makes a higher operation velocity possible and remedies the drawbacks mentioned above.

The apparatus according to the invention is characterized by a drum advancing mechanism that is so arranged that during its rotation the drum is displaced in its axial direction, while the optical system and the perforation member are mounted in fixed positions in relation to the geometrical axis of the drum and are preferably built together with the amplifier.

By such a design of the apparatus the drawbacks connected with the provision of the leads from the amplifier to the optical system and the perforation member, respectively, are avoided, the possibility being created of placing these components closely to or directly built to-

gether with the amplifier, so that the associated leads may be so short that difficulties in the electrical respect are avoided, while at the same time the risk of damage to these leads is eliminated. Furthermore, a simplified mechanical construction is made possible, and the suction of the waste products deriving from the perforation of the layer in the master is simplified, as the suction arrangement may be stationary and may be constructed with a limited suction capacity.

An embodiment of the apparatus according to the invention is characterized in that the drum is mounted so as to be rotatable around a fixed shaft and is along its outer circumference provided with a driven member which during its axial displacement remains in constant engagement with a driving member. Hereby an expedient driving of the drum is attained. The driving of the drum may be performed in various ways, and there is not necessarily any fixed mechanical connection between the driven member and the driving member, as for example the drive may be effected electromagnetically, but a constructively particularly simple design of the apparatus according to the invention is characterized in that the driven member is a rubber covering which is placed at one end of the drum and engages a long roller located parallel to the axis of the drum.

A special embodiment of the apparatus according to the invention is characterized in that the fixed drum shaft is accommodated in the apparatus so as to be easily detachable. Hereby the maintenance work on the apparatus is facilitated and a better utilization of the apparatus is made possible, as for each apparatus two or more drum systems may be used, so that while one drum system is functioning in the apparatus another drum system may be prepared, i.e., provided with an original to be scanned and a master to be perforated.

Another embodiment of the apparatus according to the invention is characterized in that the drum is journaled on the fixed shaft via roller members on three or more intermediate shafts which extend substantially in the longitudinal direction of the drum and are journaled with play in members at the ends of the drum, that these members in their planes for causing an obliquity of the intermediate shafts in relation to the fixed shaft can be turned a certain angle in relation to each other, and that for causing an axial movement of the drum, means are provided for actuating one of the intermediate shafts in the radial direction of the drum for eliminating the play. As a whole, there is by this design attained an expedient constructive provision of the axial movement of the drum. Furthermore, an expedient journalling of the drum is ensured, as the drum for the purpose of being rotated around the fixed shaft is journaled on the roller members of the intermediate shafts. By forming the bottom plates of the drum so that they can be given an angular turning in relation to each other it is possible to cause an axial movement of the drum, as by such a displacement of the bottom plates in relation to each other the intermediate shafts will be brought to take up an oblique position in relation to the fixed shaft, and the roller members located on the intermediate shafts will likewise be brought to take up an oblique position in relation to the fixed shaft, and due to this the drum will perform the desired helical movement around the fixed shaft. The possibility of engagement and disengagement provided by this embodiment will inter alia entail the advantage that while the drum is disengaged it will be possible by the exertion of a very slight force to displace the drum in its axial direction.

According to a further embodiment of the apparatus according to the invention the means for actuating an intermediate shaft is a centrifugal mechanism. Hereby one attains an automatic engagement of the axial movement of the drum when after having been started the drum reaches to desired rate of revolution. It is furthermore according to the invention expedient that over a connec-

tion, which is yieldable at least in the direction of engagement, the centrifugal mechanism influences a member which actuates an intermediate shaft in the radial direction of the drum. This embodiment is particularly advantageous in the case that the apparatus is arranged for operating at different rotation velocities for the drum. Due to the yieldable connection between the centrifugal mechanism and the actuating mechanism there will at high rotation velocities, be prevented the development of such a strong influence on the roller members that the latter will be damaged.

A special embodiment of the apparatus according to the invention is characterized in that each of the bottom plates of the drum is provided with a circular aperture through which the ends of the intermediate shafts extending within the drum protrude, that these intermediate shafts are provided with roller members, which are engaging the fixed shaft, and bosses engaging the apertures of the end plates, the said intermediate shafts being journaled with play in separate end plates lying in planes that are substantially parallel to the bottom plates, which end plates can be given an angular turning in relation to each other in the said planes, that one of the intermediate shafts in the end plates is journaled in an aperture that is elongated in the radial direction, and that this shaft in the radial direction of the drum is actuated by a centrifugal mechanism. Hereby an embodiment is attained which particularly with respect to its manufacture is advantageous, as it is possible to achieve a greater accuracy in the manufacture by the use of separate end plates while the bottom plates for the drum thus are rigidly connected to the shell of the drum.

In an expedient embodiment according to the invention the roller members may be roller-type bearings, e.g., ball bearings.

In a further embodiment of the apparatus according to the invention the separate end plates lie outside the end plates of the drum, and each is held in position by means of a spring forcing the end plates in such a way that a projecting portion thereof bears against a cam disc, while one of the said end plates is fixedly adjusted, while the other is connected to an adjustment member. Hereby a convenient possibility of adjustment for turning the end plates in relation to each other is attained for the continuous adjustment of the pitch of the helical movement of the drum along the fixed shaft.

A further embodiment according to the invention is characterized in that the centrifugal mechanism is disposed within the drum and is provided with a centrifugal body on a pivotal accommodated centrifugal arm, that this centrifugal arm under spring tension is bearing against one end of a lever, the other end of which under the influence of the centrifugal body bears against the boss on the intermediate shaft which is journaled in an elongated aperture in the end plates. The provision of the centrifugal mechanism within the drum is expedient as said mechanism hereby does not occupy space required for other purposes, and the above mentioned connection between the centrifugal mechanism and the components actuating the intermediate shaft ensures that the force exerted at a high rotation velocity does not exceed the permissible rate.

In another embodiment of the apparatus according to the invention the centrifugal mechanism comprises a further centrifugal body on a centrifugal arm which is journaled diametrically opposite the former centrifugal arm, said further centrifugal arm being connected via a connecting link to the first centrifugal arm in such a way that during swinging-out movement the two centrifugal bodies will lie substantially diametrically opposite each other. Hereby a balancing of the drum system is attained, and at the same time variations of the influence of the gravity field on the centrifugal mechanism during the rotation of the drum is avoided.

An invention associated with the invention here re-

ferred to relates to a perforation electrode system for use in an apparatus of the type stated for perforating electrostencils. This perforation electrode system according to the invention is characterized in that the perforation electrode is stationary. In contradistinction to known apparatuses, in which the perforation electrode system is moved along the drum and where an exchange of the perforation electrode is not performed until the perforation electrode system has been brought into its starting position, it is possible by the embodiment according to the invention to exchange the perforation electrode irrespectively of the position in relation to each other of perforation electrode and drum. The embodiment according to the invention furthermore entails that the suction arrangement mentioned above may be stationary.

A special embodiment of the perforation electrode system according to the invention is characterized in that while the drum is at rest the perforation electrode is cut off from its supply circuit. This provides a safeguard against electric shocks during the exchange of electrodes. Furthermore, an embodiment according to the invention is characterized in that the perforation electrode comprises an insulating handle. This provides a further protection in the case of touch. The said handle is according to the invention expediently made as a plate of T-shape.

A special embodiment of the perforation electrode system according to the invention with a perforation electrode holder and a perforation electrode fitted therein is characterized in that the perforation electrode holder is of an electrically insulating material with a guide for receiving and securing the perforation electrode. This contributes to facilitating the exchange of the perforation electrode and increases the protection against touch.

The system according to the invention may furthermore be so designed that the guide of the perforation electrode holder has such a shape that the underside of the cross beam on the T-shaped perforation electrode handle limits the penetration depth in the perforation electrode holder. This is advantageous because hereby time-consuming adjustments of the penetration depth can be avoided.

The system according to the invention may furthermore be so designed that the handle of the perforation electrode and the guide of the holder are unsymmetrical around their longitudinal axes, and this prevents the perforation electrode from being accidentally turned the wrong way.

The system according to the invention may furthermore be so designed that in or at the holder a current supply pin is provided which is under the influence of the start of the drum of the apparatus and is arranged for getting into contact with the conductive parts of the perforation electrode and for pressing this electrode forwards against the stencil placed on the drum. This entails that the perforation electrode will always be dead when the drum is stopped and possibly removed, and furthermore that the perforation electrode can in a simple way be brought to take up its correct position in relation to the stencil.

Finally, an embodiment of the apparatus according to the invention is characterized by means for locking the starting handle of the apparatus in case the drum is removed from the apparatus. Hereby is ensured that in the case the drum is removed no potential can, due to the locking of the starting handle, by mistake be applied to the perforation electrode which in this case is uncovered.

The invention will now be further explained with reference to the purely diagrammatical drawing where an embodiment of an apparatus for perforating electrostencils is shown without the invention being limited to that which will be described in connection herewith, and where

FIG. 1 shows a plan view of an apparatus according to the invention, the said apparatus being provided with a drum mounted on a fixed shaft, which drum carries an original and a master in the form of an electrostencil,

FIG. 2 an end view of the drum showing a possible journalling of the drum on the drum shaft and the driving system of the drum,

FIG. 3 is a corresponding view showing a section in the drum at right angles to its axial direction, and at the same time is here shown the placing of the perforation electrode in relation to the drum,

FIG. 4 is a section on line IV—IV in FIG. 3,

FIGS. 5 and 6 are partly sectional views of the locking mechanism in connection with the accommodation of the fixed shaft of the drum, without and with the shaft in its place, respectively,

FIG. 7 is a life-size plan view of a perforation electrode holder, and

FIG. 8 is a front view of a perforation electrode for the said holder.

In FIG. 1 is shown a plan view of an apparatus for perforating electrostencils. This apparatus comprises a housing with an upper cover plate 1 and two terminal plates 2 and 3. The front part of the apparatus comprises a trough-shaped hollow 20, see FIG. 5, and in this a rotatable drum 5 is journalled on a shaft 4. On the curved surface of the drum 5 an original 6 and an electrostencil 7, respectively, can be clamped. The original 6 is secured on the left part of the drum 5 by means of a fixing bar 8, while the stencil 7 is secured by means of a corresponding fixing bar 9. These fixing bars 8 and 9 may have any suitable design which will not be further described here, and by means of operating handles 10 and 11 they are operated for the fixing and release, respectively, of the original of the stencil. To protect the original which is to be copied and which may be a drawing, a typed document, a photograph, or the like and to attain an easy fixing in the case that the original does not fit the drum as regards size one may use a sheet, adapted to the purpose, of a transparent material which is put over the original and secured by means of the fixing bar 8. As regards the stencil, a stencil is used of a size fitting accurately around the drum, which stencil is clamped by means of the fixing bar 9.

In the following will be given a brief description of the principle forming the basis for the apparatus. The drum 5 of the apparatus is intended for rotating around the fixed shaft 4 and is furthermore, as will be described in detail in the following, intended for moving axially along the shaft 4 with a slight pitch. A point on the surface of the drum will hereby be made to describe a helical path. From an optical system 12 a thin light beam is directed towards the drum and the original place thereon. Part of the light impinging on the original will be reflected to a photosensitive element built into the optical system. The part of the incident light, which is reflected from the original to the photosensitive element, will represent the light value at the particular point of the original. When the individual points on the surface of the drum 5 describe a helical path with a slight pitch along the drum shaft 4, there may from the photosensitive element in the optical system 12 be derived an electrical signal corresponding to the momentary light value in the helical path scanned on the original. The signals from the photosensitive element, which may, e.g., be a photocell, a photomultiplier tube, or a photoresistance, are fed to an amplifier which is built into the apparatus and located under the cover plate 1 and which is arranged for supplying under control of the signals transmitted a suitable potential to a perforation electrode 13. This perforation electrode 13, which is placed in a perforation electrode holder 14 and is provided with an insulating handle 15, is shown in detail in FIG. 8 of the drawing. The perforation electrode 13 is so mounted that it touches the stencil 7 and during the rotation of the drum slides along the surface of the stencil. When a suitably high potential during the rotation of the drum and under control of the electric signals derived from the optical system 12 is supplied to the perforation electrode 13, a puncturing of the elec-

trostencil 7 will occur. Consequently, a perforation, controlled by the original, of the electrostencil will occur. When the perforation of the stencil is finished, i.e., when the whole original has been scanned, the stencil may be removed and placed in a duplicating machine where a desired number of copies can be produced.

The amplifier built into the apparatus may, e.g., convert the signals, which by means of the photosensitive element are derived from the light reflected from the original, in such a way that dark portions on the original are converted into potential on the perforation electrode, while light portions on the original block the potential on the perforation electrode. The conversion may, however, also be the reverse, so that light portions on the original give potential on the perforation electrode, while dark portions block this potential. The amplifier, which will otherwise not be further described, is provided with two adjustment buttons 32 and 33, one of which serves for adjusting the potential desired on the perforation electrode, while the other adjustment button is used for adjusting a threshold value which determines the point on a grey-value scale from which perforation of the stencil is to be initiated. An indicator 16 serves for indicating whether at a given moment during the rotation of the drum a perforation of the stencil is performed or not. By means of this indicator it may thus be ascertained whether the zone of the original located before the optical system of the apparatus at a given time has a light value above or below the threshold value set in the apparatus.

At the left and right ends of the drum 5 a covering 17 and 18, respectively, is provided, e.g., in the form of an annular member of rubber, plastic, or the like. The covering 18 engages a driving roller 19 disposed in the trough-shaped portion 20 of the apparatus. The driving roller 19 may be driven over a gear mechanism from a suitable driving motor. The driving roller 19 is of a length corresponding to about half the length of the drum, so that this driving roller is in constant engagement with the covering 18 during the helical movement of the drum around the fixed shaft 4.

In the apparatuses heretofore used of the type referred to the drum, which carries original and stencil, is mounted axially unshiftable and is only intended for rotating. To achieve a scanning across the original and a corresponding perforation of the stencil the optical system and the perforation electrode in these apparatuses heretofore used must be mounted movably, e.g., by using a threaded spindle which causes an axial movement of these components in relation to the drum, whereby the helical scanning desired is achieved. In the apparatus here described the optical system 12 and the perforation electrode holder 14 with the perforation electrode 13 mounted herein form fixed components of the apparatus so that it is unnecessary to have long movable leads leading to these components. On the contrary, they can be built direct together with the associated amplifier mentioned above, and this is a great advantage mechanically as well as electrically.

The starting of the drum 5 is effected by operating a starting handle 21. The drum 5 is over suitable means, which will be described later, so accommodated that it can rotate on the shaft 4, and this accommodation is so arranged that while the drum is rotating it will move in the axial direction along the shaft 4 with a slight pitch. By means of a control handle 22 this pitch of the helical movement along the shaft 4 is adjusted.

Under an operating panel 23, which carries the adjustment buttons 32 and 33 and the indicator 16 and the starting handle 21, two detachable covers 24 and 25 are mounted at either side of the perforation electrode holder 14. These covers 24 and 25 cover filters inserted in air ducts, through which the particles and gases produced by the perforation of the stencil are sucked out. This ventilation around the perforation electrode may in the present apparatus in contradistinction to what has been used

in the constructions hitherto used be performed through fixed ventilation ducts. A fan coupled to the driving motor and not shown in the drawing provides a suitable suction in the said ducts.

A stop mechanism 26 is mounted adjustably in a slot 27 and is provided with a stop arm 28 which projects into the trough-shaped portion 20 of the apparatus and is disposed in the path for the drum 5. When the drum 5 hits the arm 28, there will mechanically or electromechanically occur a return of the starting handle 21, and hereby the operation of the drum is stopped. The stop mechanism 26 can be adjusted in the slot 27 corresponding to the width of the original to be scanned.

The shaft 4, on which the drum is intended to rotate, is at the right end of the trough-shaped portion 20 accommodated in a bearing 31 and is at the left end accommodated in a somewhat similar bearing which is covered with a cover 30. Under the cover 30 there is a locking mechanism which inter alia comprises a locking arm 29, see FIGS. 5 and 6, which is in connection with the starting handle 21. The design of the said locking mechanism is further described in connection with FIGS. 5 and 6 of the drawing. The locking mechanism is so arranged that when the drum is at rest the shaft 4 may after having been turned a quarter of a turn be displaced to the right, so that the left end of the shaft 4 will get out of the cover 30, and thereafter the shaft 4 and the drum mounted thereon may be removed from the apparatus. In combination with the locking arm 29 the locking mechanism under the cover 30 takes care of that the starting handle 21 cannot be actuated when the drum has been removed from the apparatus and this protects against a possible supply of potential to the perforation electrode 13 which becomes accessible when the drum is removed. This simple removal of the drum from the apparatus entails that one may, e.g., advantageously use two or more drums for the same apparatus as the other drum, while the apparatus operates with the first drum, may be prepared, viz., by being provided with a desired original and a stencil.

The apparatus shown in FIG. 1 may be provided with a lid-shaped part, not shown, which covers the portion of the apparatus which is disposed in front of the operating panel 23. Hereby the components of the apparatus are protected against dust and damage.

In FIGS. 2, 3, and 4 is shown a possible embodiment of the mechanism with which the drum 5 is journaled on the fixed shaft 4. FIG. 2 shows viewed from outside one end of the drum, e.g. the end of the drum 5 which in FIG. 1 is shown to the far left.

The bottom of the drum consists in the case shown of a circular end plate 35 on the outer circumference of which the covering 17 is placed, e.g. in the form of a rubber ring. In FIG. 2 is furthermore shown the location of the long driving roller which engages the covering 18 at the opposite end of the drum. Furthermore the operating handle 10 for the fixing bar 8 is shown. The end plate 35 is provided with a circular cut in the form of an aperture 36, and out through this aperture 36 project the ends of three intermediate shafts 37, 38, and 39 which extend through the entire length of the drum. An annular spring 40, see FIG. 3, is carried through bores in the three intermediate shafts 37, 38, and 39 and serves for guiding these intermediate shafts in relation to each other during the mounting of the shafts in the drum. One each of the intermediate shafts 37, 38, and 39 a roller-type bearing is placed, e.g., a ball bearing or the like, 41, 42, and 43, respectively, and a boss 44 45, and 46, respectively. The intermediate shafts 37 38 are carried through openings in a separate end plate 47 which is located outside the end plate 35 of the drum. This separate end plate 47 serves for securing the three intermediate shafts 37, 38, and 39 in fixed positions in relation to each other, but the opening, through which the intermediate shaft 39 is carried through the end plate 47, which opening is designated by 48, is

shaped as an elongated opening permitting a movement of the intermediate shaft 39 in the radial direction. On each of the intermediate shafts a locking ring 49 is mounted for securing the separate end plate 47.

Each of the bosses 44, 45, and 46, which are circular, has a circular abutment 50 which abuts on the inner surface of the end plate 35 of the drum, while each of the bosses 44-46 bears against the edge of the aperture 36. The bearing mechanism is furthermore so dimensioned that with their outer races the roller-type bearings 41-43 press lightly on the fixed shaft 4, while at the same time each of the three bosses 44-46 is in contact with one point of the edge of the aperture 36. As the intermediate shaft 39 is journaled in an elongated opening 48 in the separate terminal plate 47, a force exerted on this intermediate shaft 39 or on the boss 46 mounted hereon in the direction towards the shaft 4 will press the roller-type bearings with a certain pressure against the fixed shaft 4. An engagement mechanism for exerting such a force on the boss 46 will later be described in connection with FIG. 3. This engagement mechanism consists of a centrifugal mechanism which engages the axial movement of the drum 5 when a suitable rate of rotation has been obtained.

In the following will be explained how the drum 5 is given an axial movement along the fixed shaft 4 while at the same time it is rotating. The separate end plate 47 is provided with an opening 55 to which a helical spring 53 is connected, the other end of which is secured to a pin 54 on the end plate 35 of the drum. The spring 53 presses a projecting part 51 on the separate terminal plate 47 against a cam disc 52. This cam disc, which can rotate, is provided with a control handle which is not shown in FIG. 2, but is designated by 22 in FIG. 1. The drum journaling mechanism, which has now been described for one end of the drum 5, is constructed correspondingly at the other end of the drum apart from the fact that the projecting part, corresponding to the projecting part 51 in FIG. 2 at the opposite end of the drum, engages a fixed cam which is intended for being adjusted during the adjustment of the apparatus at the factory. This will consequently entail that the entire journaling mechanism at the opposite end of the drum 5 is located in a fixed position in relation to that shown in FIG. 2. By a turning of the cam disc 52 in FIG. 2, e.g., in the direction indicated by an arrow, the separate end plate 47 will due to the projecting part 51 and against the effect of the spring 53 cause a movement of the intermediate shafts 37-39 in the direction indicated by arrows. As the opposite ends of these intermediate shafts are, as mentioned above, in a fixed position, this turning of the cam disc 52 will entail that the three intermediate shafts 37-39 will no longer lie parallel to the fixed shaft 4, but will be made to take up oblique positions in relation to the latter. The obliquity of the intermediate shafts 37-39 is made possible by their being, as mentioned above, journaled with a certain play in the separate end plate 47 and the corresponding separate end plate at the opposite end of the drum.

Due to the fact that the intermediate shafts 37-39 and hereby also the shafts for the roller-type bearings 41-43 are no longer parallel to the fixed shaft 4, the races for the roller-type bearings will during the rotation of the drum not move along a circular path across the fixed shaft 4, but on the contrary along a helical path. This causes, when the drum 5 is brought into rotation by means of the driving roller 19 and when the engagement mechanism actuates the intermediate shaft 39 radially inwards, the drum 5 to perform a helical movement along the fixed shaft 4, and the pitch for this helical movement may be varied by turning the cam disc 52. It should be noticed that the pitch of the helical movement is very slight in order that the scanning performed by the movement may result in a detailed reproduction of the original on the stencil. Viewed in relation to FIG. 1 this therefore means that the optical system 12 scans a helical path with a

slight pitch on the original 6, while the perforation electrode 13 performs a perforation along a corresponding helical path on the stencil 7, and by turning the control handle 22 the obliquity of the roller-type bearings may be varied within wide limits, so that the pitch for the movement of the drum 5 along the shaft 4 and thereby the degree of fineness of the scanning performed may be adjusted at will.

Next, there will in connection with FIGS. 3 and 4 of the drawing be given a further explanation of the mechanism which by centrifugal effect engages the axial movement of the drum 5. In FIG. 3 is shown a section in the drum 5 at right angles to the axis of the drum. Hereby a view is obtained of the journaling mechanism at one end of the drum viewed from the inside. FIG. 4 shows a section on line IV-IV in FIG. 3 and serves for further illustrating the details of this figure.

The reference numeral 60 indicates the shell of the drum, and an aperture 61 in this shell is intended for accommodating one of the fixing bars which in the present figure has been omitted for the sake of perspicuity. On one shaft end 62 an angular lever 63 is journaled, one end 64 of which with a curved face abuts against the abutment 50 on the boss 46. The opposite end 65 of the angular lever 63 is bent over and abuts on a centrifugal arm 66 which carries a centrifugal body 67. The centrifugal arm 66 is likewise journaled on the shaft end 62, and the opposite end of the centrifugal arm 66 in relation to the centrifugal body 67 is designated by 68 and is intended for engaging a stop pin 69. A spring 70 presses the angular lever 63 and the centrifugal arm 66 against each other with a certain pressure, the said spring being led through openings in the end 65 of the angular lever and the centrifugal arm 66, respectively. When the drum 5 is rotated by means of the driving roller 19, the centrifugal body 67 will be forced outwards in the direction towards the shell 60 of the drum. Hereby will also the angular lever 63 be turned around the shaft end 62, and the end 64 of the angular lever 63 will press against the abutment 50 on the boss 46. Hereby the roller-type bearings 41-43 are pressed against the fixed shaft 4, and the drum 5 will besides its rotation perform the axial motion mentioned above along the shaft 4 in dependency of the obliquity of the roller-type bearings 41-43 caused by means of the cam disc 52. It should be mentioned that the end 64 of the angular lever 63 which bears against the abutment 50 on the boss 46 is made with such a curvature that the boss 46 is pressed farther and farther radially inwards as gradually the angular lever 63 is being turned. In this connection it should be pointed out that in order to in a simple manner making possible the said radial movement the boss 46 is made slightly smaller in diameter than the two other bosses 44 and 45. The centrifugal mechanism comprises a further centrifugal arm 71 which is journaled on a shaft end 72 and carries a centrifugal body 73. The centrifugal arm 71 is by means of a connecting link 74 connected to the centrifugal arm 66. The connecting link 74 is rotatably connected to the said centrifugal arms by means of connection bearings 75 and 76, respectively. The two centrifugal arms are so interconnected that their effects support each other, and by the use of two mutually oppositely mounted centrifugal bodies in part a balancing of the drum system, in part a compensation of the effect of the gravity, is obtained.

The spring 70, which presses the bent-over end 65 on the angular lever 63 against the centrifugal arm 66, furthermore serves as a protection against a too large force on the roller-type bearings of the bearing system at a high rate of revolution. If, e.g., the apparatus is intended for operating at two or more speeds of rotation for the drum 5, the centrifugal mechanism is so dimensioned that a suitable contact pressure for the roller-type bearings 41-43 against the fixed shaft is attained at the lowest speed of the drum 5, and the spring 70 ensures that the roller-

type bearings are not subjected to higher forces when the speed of rotation is increased.

After this description of an embodiment of a bearing mechanism for the drum 5 it should be mentioned that it would also be possible to journal the intermediate shafts 37-39 direct in the end plate 35 which in this case should be constructed so as to be rotatable in relation to the corresponding end plate at the opposite end of the drum to make possible an obliquity of the intermediate shafts in relation to the fixed shaft 4. In most cases, however, the design described above with separate end plates 47 will be preferable for reasons of manufacture and mounting.

In FIG. 3 is furthermore in section shown a perforation electrode holder 14 with a perforation electrode 13 mounted in it, and the perforation electrode holder 14 comprises a displaceable part 80 which by means of a spring 81 is pressed against the insulating handle 15 on the perforation electrode. When the displaceable part 80 is pulled back against the pressure of the spring 81, the perforation electrode handle 15 is released so that the perforation electrode can be pulled out of the holder 14. The perforation electrode holder 14 and the perforation electrode 13 proper with the associated handle 15 are furthermore shown in more detail in connection with FIGS. 7 and 8 of the drawing. The perforation electrode 13 consists of a conductive material to which the insulating handle 15 is secured. The lower end of the perforation electrode 13 terminates in a thin wire 82, e.g., of wolfram or some other heat-resisting conductive material. The wire 82 slides across the stencil 7 placed on the drum 5 and, when potential is supplied to the perforation electrode 13, the wire causes a puncturing through the stencil 7. A current supply pin 83 is via a pivot arm 88, which in order to prevent a short circuiting of the potential to the current supply pin 83 may be of an insulating material, and a shaft 109 in mechanical connection with the starting handle 21 of the apparatus and is, when this starting handle is actuated, pressed against the perforation electrode 13 in such a way that the wire 82 is led in against the stencil on the surface of the drum 5. The pin 83 at the same time serves as current supply means to the perforation electrode 13. The perforation electrode 13 may be made of resilient thin plate and may be provided with suitable bends to attain a correct location in relation to the stencil. On the lower part of the electrode 13 a loosely mounted rivet 84 is placed which serves for damping the oscillations of the electrode 13 due to the movement of the wire 82 across the stencil on the drum 5.

FIG. 5 shows, viewed from the inside, the left end plate 2 in the apparatus shown in FIG. 1. The reference numeral 30 indicates the cover covering a locking mechanism for the shaft 4 of the drum. The cover 30 is provided with a cut 90 for the shaft 4 and for a guiding pin 91, see FIG. 6, placed on this shaft. The shaft 4 is intended for resting in a bearing bush 92 in the end plate 2, and under the cover 30 is furthermore provided a pawl 93 which by means of a spring 94 is pre-stressed in such a way that a stop pin 95 will abut on the bearing bush 92 when the shaft 4 has been removed. An abutment 89 on the bearing bush 92 ensures that the shaft 4 during mounting can be turned only clockwise, viewed from the picture in FIG. 5. From the locking mechanism under the cover 30 a locking arm 29 is in connection with the starting handle 21 of the apparatus. The locking arm 29 is by means of elongated apertures 98 and 99 journaled displaceably on guiding pins 96 and 97 on the end plate 2. The starting handle 21 is connected to a pivot arm 100, the pivot point of which is shown by 101. By means of a guiding pin 102 on the locking arm 29 a rotatable connection is provided between the locking arm 29 and the pivot arm 100, the guiding pin 102 being movable in an elongated aperture 103 in the pivot arm 100. A spring 104 is connected to the pivot arm 100 and holds the starting handle 21 in the position shown in FIG. 5. A latch 105, which turns around a point 107 and

has a cut 106, rests on a locking pin 108 on the pivot arm 100. The starting of the apparatus is effected by the starting handle 21 being moved outwards against the prestress from the spring 104 until the locking pin 108 gets into engagement with the cut 106 on the latch 105. This starting manoeuvre cannot be performed, however, when the conditions are as shown in FIG. 5, the pawl 93 preventing the locking arm 29 from being moved towards the left.

Only when the shaft 4 with the guiding pin 91 mounted on it is led through the cut 90 in the cover 30 into the bearing bush 92 and is turned a quarter of a turn clockwise the pawl 93 of the guiding pin 91 will be pressed downwards against the tensions from the spring 94, and it will then be possible to perform the starting of the apparatus by means of the starting handle 21, as now the locking arm 29 can be displaced into the position shown in FIG. 6 in which it bears against the guiding pin 91, whereupon the latch 105 engages the locking pin 108 and locks the starting handle 21 in its engage position. The latch 105 locking the starting handle 21 can in a manner not shown be in connection with the adjustable stop mechanism 26 which is described in connection with FIG. 1 and which when the drum engages the arm 28 of this mechanism causes a turning of the latch 105 so that the locking pin 108 gets out of engagement with the cut 106, whereby the starting handle 21 is released and under the tension from the spring 104 returns to the position shown in FIG. 5.

To the pivot arm there may at the pivot point 101 be secured a shaft 109 which within the apparatus extends parallel to the drum shaft 4. This shaft 109 is over the arm 88 in mechanical connection with the current supply pin 83 for the perforation electrode holder 14, see FIG. 3, and may furthermore cause the engagement of the driving roller 19 for the drum, see FIGS. 1 and 2.

The locking mechanism described above in combination with the starting mechanism of the apparatus ensure that the starting handle 21 can only be moved into an engaged position when the shaft has been mounted in its place in the bearing bush 92, and the shaft 4 cannot be removed from the apparatus until the starting handle 21 is in the disengaged position. Due to the locking of the starting handle 21 when the drum has been removed the risk of having voltage on the perforation electrode 13 is avoided, the said perforation electrode being uncovered in the trough-shaped portion 20 when the drum 5 is removed.

In FIG. 7 is shown a life-size picture of the perforation electrode holder 14 viewed from above. The displaceable part 80 on the electrode holder is here shown in a position corresponding to the perforation electrode being inserted, so that a narrow slot 109 is produced between the part 14 and the part 80. Semicircular cuts 110 and 111 in the holder 14 and the displaceable part 80, respectively, ensure that the perforation electrode can be inserted and removed without the wire 82, see FIG. 3, mounted at the end of the electrode, being bent or damaged. As mentioned in connection with FIG. 3 the displaceable part 80 is by means of a spring 81 pressed against the part 14 and retains the handle 15 of the perforation electrode 13 in the slot 109.

In FIG. 8 is shown a front view of a perforation electrode. The wire 82, which is intended for sliding across the electrostencil during the rotation of the drum past the perforation electrode, is at 112 connected to the perforation electrode 13, e.g. by soldering or welding. The reference numeral 84 indicates the said loose rivet which serves for damping oscillations of the perforation electrode. An elongated aperture 113 in the perforation electrode serves for obtaining suitable resiliency properties. The perforation electrode 13 may in any suitable way be secured to the insulating handle 15, e.g., by means of bent-over tongues carried through openings in the handle 15, as indicated by 115. The insulating handle 15

may be made of a suitable insulating material, and it may e.g., be stamped out of a suitable thick plastic. A wider part 116 on the insulating handle 15 serves for establishing the penetration depth of the perforation electrode in the perforation electrode holder 14. It may be expedient to design the insulating handle 15 unsymmetrically around the longitudinal axis of the perforation electrode, e.g., with a form as indicated by a dotted line 117. The perforation electrode holder must then of course be shaped accordingly, and in this way it can be ensured that the perforation electrode can only be inserted into the holder 14 when it is turned the right way.

The invention is not limited to the embodiments here described and shown in the drawing, as numerous modifications may be performed without deviating from the scope of the associated claims. It will e.g., be obvious that the present invention inter alia may be utilized in connection with offset, production of single copies, etc., and on the whole where it is a question of perforating a layer in a master.

We claim:

1. An apparatus for perforating at least a layer on a master copy according to an original comprising a shaft detachably mounted in said apparatus, a drum rotatably mounted on said shaft, means for securing said original and master copy on the curved surface of the drum in side-by-side relation along the longitudinal direction of the drum, a fixed optical system having a light source, photosensitive element and means to amplify signals developed by said element, said optical system being positioned to scan said original as said drum rotates, fixed perforating means responsive to the output of said optical system and positioned to perforate said master copy, and driving means for rotating said drum while displacing it axially.

2. An apparatus according to claim 1 further comprising a driving band mounted on the outer circumference of said drum, said driving means having a driven member which is in constant engagement with said driving band as said drum is rotated and axially displaced.

3. An apparatus according to claim 2 in which said driving band is a rubber covering placed on one end of the drum and said driving means is an elongated roller the axis of which is parallel to the axis of said shaft and drum.

4. An apparatus according to claim 1 further comprising end members at the ends of the drum, at least three intermediate shafts mounted on said end members extending substantially in the longitudinal direction of said drum, roller members on each of said intermediate shafts, said end members in their planes providing for an obliquity of said intermediate shafts with respect to said shaft, and means for moving one of said intermediate shafts in the radial direction of said drum for eliminating play and providing said axial movement of the drum.

5. An apparatus according to claim 4 further comprising centrifugal mechanism means for actuating said one of the intermediate shafts.

6. An apparatus according to claim 5 further comprising yieldable connection means biasing said means for moving said one of said intermediate shafts in the radial direction of said drum.

7. An apparatus according to claim 4 in which said end members are bottom plates substantially closing the respective ends of said drum.

8. An apparatus according to claim 4 further comprising bottom plates mounted on each end of said drum and having a central circular aperture therein, said end plates being adjustably mounted adjacent said bottom plates with

said intermediate shafts protruding through said aperture, said end plates being adjustable to vary the angular relation of the plane of said plates with respect to each other, each said roller engaging with said shaft and having bosses engaging said aperture, at least one of said intermediate shafts being journaled in said end plate in an aperture which is elongated in the radial direction, and centrifugal means for moving said at least one intermediate shaft in the radial direction.

9. An apparatus according to claim 8 wherein said roller members are roller-type bearings.

10. An apparatus according to claim 8 in which said end plates lie outside said bottom plates of the drum, a projecting part on said end plates, cam disc means fixedly mounted on said bottom plate, spring biasing means biasing said projecting part into contact with said cam disc means.

11. An apparatus according to claim 8 in which said centrifugal mechanism means is disposed within said drum and comprises a centrifugal body mounted on a journaled centrifugal arm, lever means journaled against said intermediate shaft journaled in an elongated aperture, spring means biasing said centrifugal arm against said lever means.

12. An apparatus according to claim 11 further comprising a second centrifugal body mounted on a second centrifugal arm journaled diametrically opposite said first centrifugal arm, connecting link means connecting said centrifugal arms so that during their swing-out movement said centrifugal bodies lie substantially diametrically opposite each other.

13. An apparatus according to claim 1 wherein said fixed perforating means comprises an electrode, current supply means for said electrode, and means to energize said electrode only while said drum is rotating.

14. An apparatus according to claim 13 further comprising an insulating handle on said perforation electrode.

15. An apparatus according to claim 14 wherein said insulation handle is T-shaped.

16. An apparatus according to claim 13 further comprising an electrode holder of electrically insulating material and having guide means for receiving and securing said perforation electrode in said holder.

17. An apparatus according to claim 16 in which the underside of said guide means is formed in a T-shape to thereby limit the penetration depth of said electrode into said holder.

18. An apparatus according to claim 17 in which said handle of said electrode and said guide means of said holder are unsymmetrical about their longitudinal axes to thus assure correct assembly.

19. An apparatus according to claim 16 further comprising current supply switching means mounted on said holder responsive to the starting of said drum and operative to energize said perforation electrode while pressing it forward against said master stencil on said drum.

20. An apparatus according to claim 1 further comprising means for locking said apparatus when said drum is removed therefrom.

References Cited

UNITED STATES PATENTS

2,191,945	2/1940	Tilton	178—6.6
2,705,259	3/1955	Lant	178—6.6

ROBERT L. GRIFFIN, *Primary Examiner*.

H. W. BRITTON, *Assistant Examiner*.