Dec. 8, 1936. M. D. McFARLANE ET AL 2,063,614

METHOD AND APPARATUS FOR MAKING PRINTING PLATES

Filed Dec. 14, 1931 5 Sheets-Sheet 1

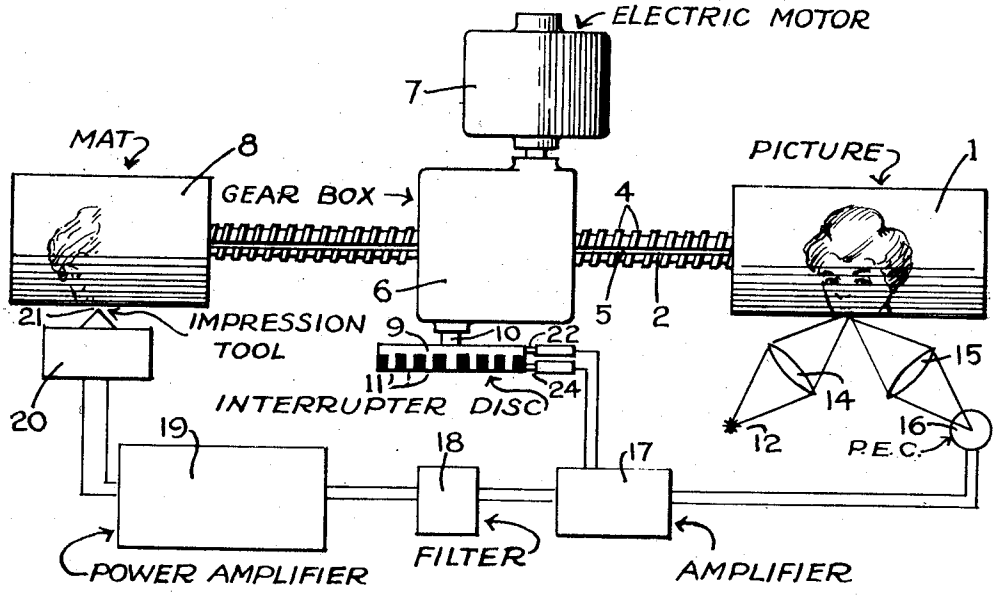


Fig. 1

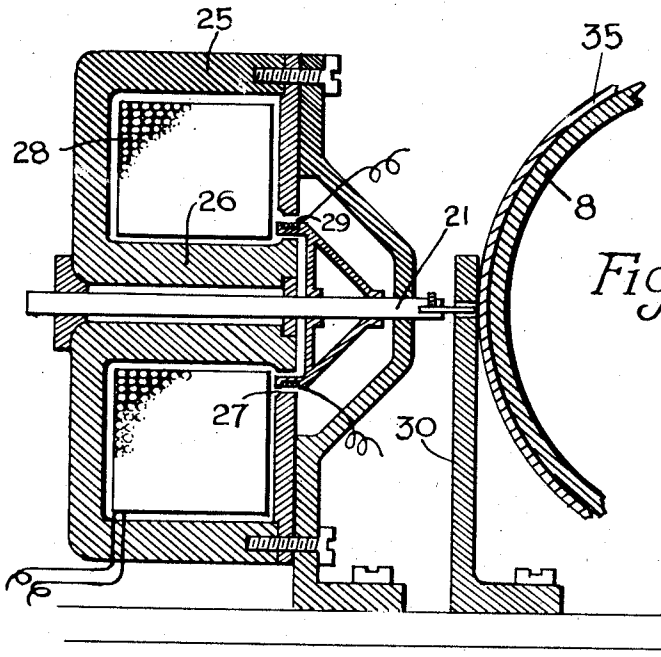


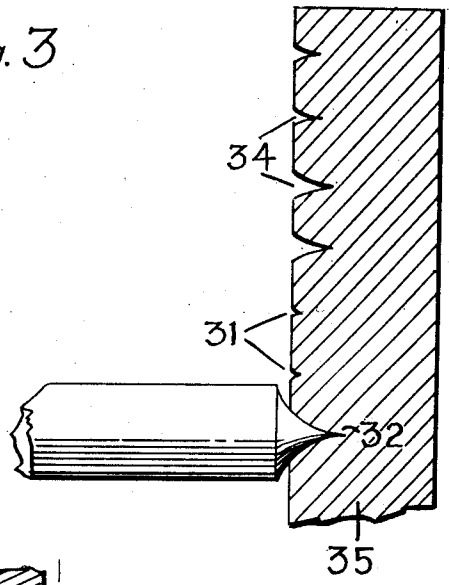
Fig. 2

Maynard D. McFarlane
Gabriel Kuiss
INVENTORS
BY Ramsey & Kent
ATTORNEYS

METHOD AND APPARATUS FOR MAKING PRINTING PLATES

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Fig. 3



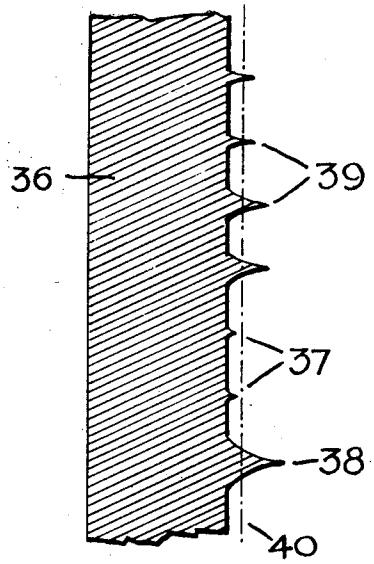


Fig. 4

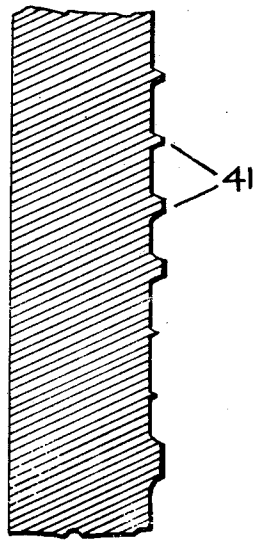


Fig. 5

Raymond D McFarlane
Gabriel Kern
INVENTORS
BY Ramsey & Kent
ATTORNEYS

Dec. 8, 1936. M. D. McFARLANE ET AL 2,063,614

METHOD AND APPARATUS FOR MAKING PRINTING PLATES

Filed Dec. 14, 1931 5 Sheets-Sheet 3

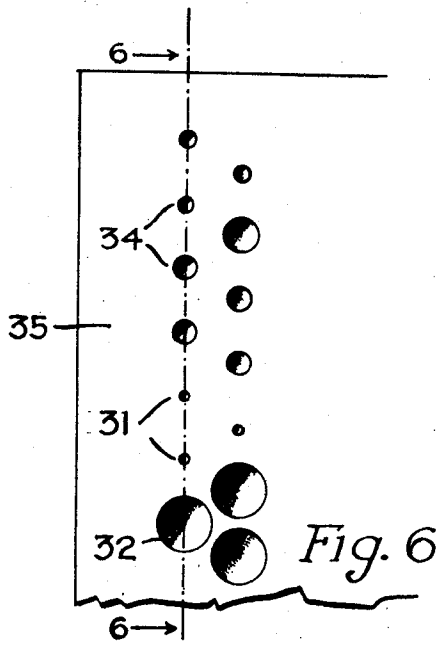


Fig. 6

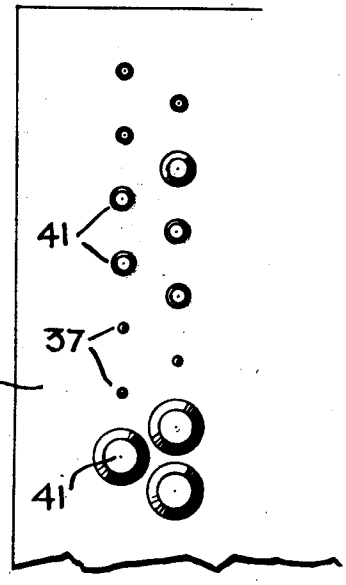


Fig. 7

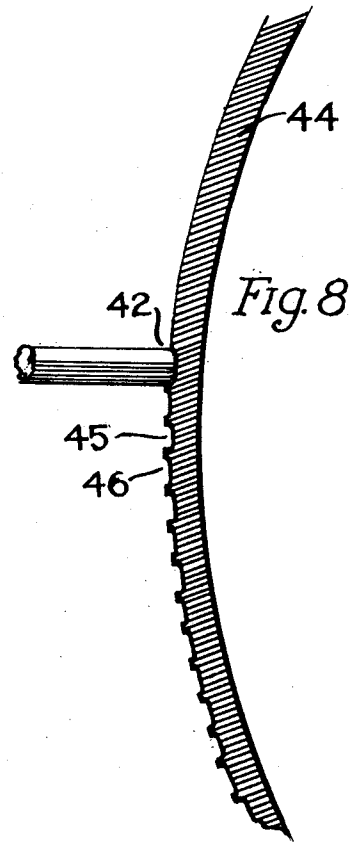


Fig. 8

Maynard D. McFarlane
Gabriel Kunn
INVENTORS
BY Ramsey & Kent
ATTORNEYS

Dec. 8, 1936. M. D. McFARLANE ET AL 2,063,614

METHOD AND APPARATUS FOR MAKING PRINTING PLATES

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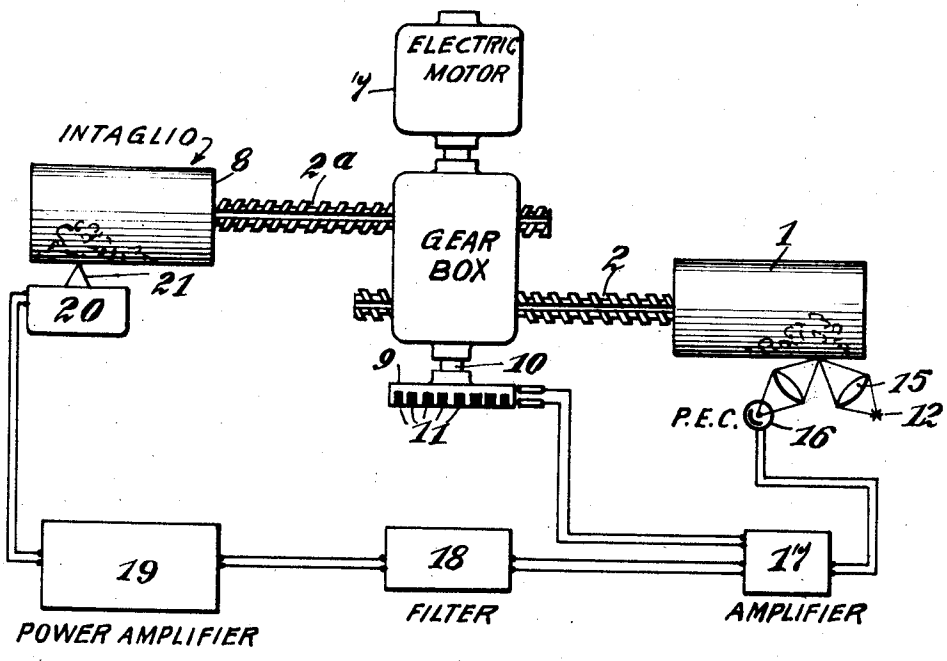


Fig. 9.

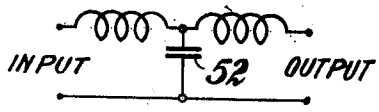


Fig. 10.

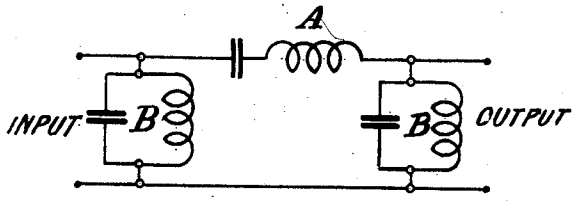


Fig. 11.

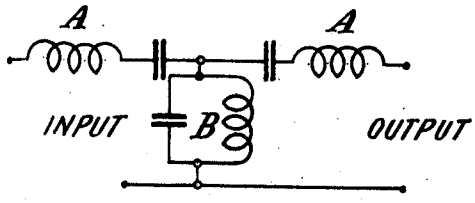


Fig. 12.

INVENTORS
Maynard D. McFarlane
BY and Gabriel Kinn
Ramsey & Kent
Their ATTORNEYS

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METHOD AND APPARATUS FOR MAKING PRINTING PLATES

Filed Dec. 14, 1931 5 Sheets-Sheet 5

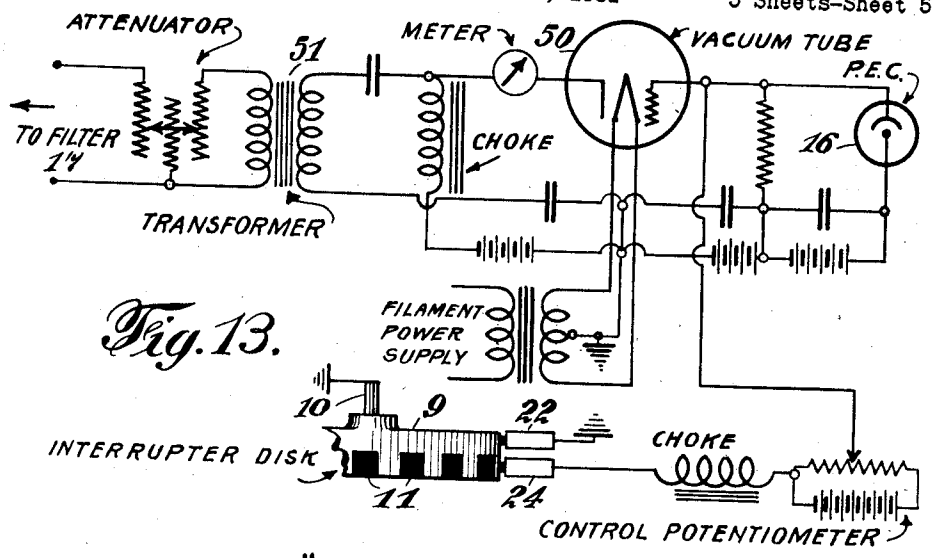


Fig. 13.

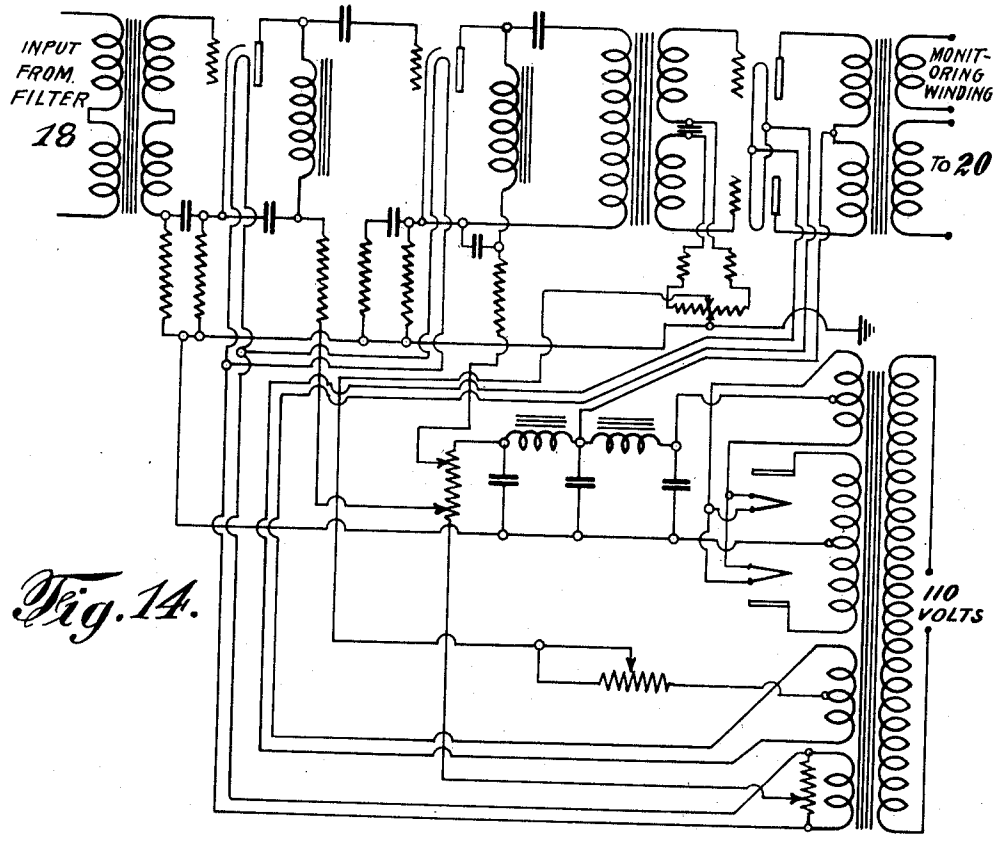


Fig. 14.

INVENTORS
Maynard D. McFarlane
and Gabriel Kinn
BY Ramsey & Kent
their ATTORNEYS

Patented Dec. 8, 1936

2,063,614

UNITED STATES PATENT OFFICE

2,063,614

METHOD AND APPARATUS FOR MAKING PRINTING PLATES

Maynard D. McFarlane, New York, and Gabriel Kinn, Hempstead, N. Y., assignors to Mackinner Corporation, New York, N. Y., a corporation of New York

Application December 14, 1931, Serial No. 580,988

5 Claims. (Cl. 178—5)

The present invention relates to the photo-electric production of printing plates.

The present invention comprises a method and apparatus for producing a matrix from which a printing member may be produced like a stereotype plate. The invention also contemplates directly producing a printing member which may be used for plate printing such as the process known in the art as "Roto-gravure".

Where half-tone cuts are used in the printing, it is common practice to raise the dark areas of the cut by striking the back of the cut over these areas. This is known in the art as "bumping". The present invention also contemplates steps which bring out the heavy shaded portions of a picture in proper contrast without special treatment of the printing plate.

According to the present invention, a picture to be analyzed and reproduced photo-electrically is scanned in such manner as to produce a variable electric current because of the light and shade variations in the picture under the scanning point. This variable electrical current is controlled so as to operate a reproducing member which acts on a receiving plate or member to produce a result which corresponds to unit area tone values of the original picture.

The preferred operation is that of an intermittently operated impression point which is forced into the receiving plate or member a greater or lesser distance dependent upon the tone value of the corresponding unit area of the original which has established and determined the effective value of the controlling current for the particular area.

Preferably, the material operated on by the impression point comprises a substance similar to a stereotype mat. After the operation is completed, the stereotype mat will be covered with minute indentations which vary in depth and size according to the tone values of the original picture, and preferably, the dark tones of the picture are represented on the mat by deep wide mouthed indentations while the light unit areas of the picture are represented by small shallow indentations.

The prepared mat may now be used as a matrix for stereotype casting and the resulting casting has a surface covered with small upstanding projections of different heights and of different sized bases. The projections are now levelled to a level slightly higher than that of the smallest projections. The result is a printing surface similar to a half tone surface, because the projections relating to the dark tone areas of the picture are now the largest topped projections on the plate and these projections stand slightly above the minute projections which correspond to the light areas of the picture. This obviates "bumping" the plate, or providing a special "make ready" for the printing plate. This plate is now ready for the ordinary steps in printing, where a half tone plate would be used.

Where the present invention is to be used for "Roto-gravure" type of printing, the printing plate formed directly by the impression point is available for the printing process without the intermediate step of forming or casting a printing surface. In the "Roto-gravure" method of printing, ink is retained in recesses in the plate and the recesses for the dark areas are preferably larger or deeper than the recesses for the light areas. From the foregoing, it will be observed that the product of the impression point in the present case is a plate which corresponds to the requirements for "Roto-gravure" work.

Other and further objects of the present invention will in part be obvious and will in part be pointed out hereinafter in the specification following by reference to the accompanying drawings, forming a part hereof.

The present invention may be carried out by methods and apparatus differing from those disclosed herewith without departing from the spirit of the invention. Therefore, the disclosure herewith is to be understood as illustrative and not in the limiting sense.

Fig. 1 is a diagrammatic representation of the preferred form of apparatus for carrying out the present invention.

Fig. 2 is a detail view showing a portion of the impression tool operating device in section.

Fig. 3 is a detail view partly in section showing the operation of the impression tool in producing a matrix.

Fig. 4 is a detail view showing a section through line 6—6 of a casting from the matrix shown in Fig. 6.

Fig. 5 is a detail sectional view of the casting shown in Fig. 4 with the tops of the projections removed to form printing surfaces.

Fig. 6 is a plan view of the face of the matrix shown in Fig. 3.

Fig. 7 is a plan view of the printing plate shown in Fig. 5.

Fig. 8 is a section through a plate made according to the present invention and adapted for "Roto-gravure" printing.

Fig. 9 is a diagrammatic drawing similar to Fig. 1 but showing separate screw drives for the original and the reproduction.

Figs. 10, 11, and 12 show conventional filter circuits which may be used in the apparatus shown in Figs. 1 and 9.

Fig. 13 is a schematic diagram showing a suitable arrangement of interrupter and photo-electric cell connections to an amplifier.

Fig. 14 is a schematic diagram of a conventional power amplifier suitable for use in the apparatus shown in Figs. 1 and 9.

Referring to the drawings and more especially to Fig. 1, which diagrammatically illustrates a preferred form of the invention, a drum 1 carries the picture to be scanned. The drum is mounted upon a shaft 2 which is provided with helical threads 4 and also a keyway 5. This shaft extends through a gear box 6 in which are gears driven by an electric motor 7, whereby one of the gears is provided with a key adapted to fit the keyway 5 of the shaft 2, and another gear carries a helical nut which fits the threads 4 on the shaft 2 whereby the differential motion between the gear carrying the key and the gear carrying the helical nut determines the resultant axial movement of the shaft 2 and also the angular velocity of the drum 1. This gear box arrangement does not of itself form a part of the present invention and, therefore, is indicated on the drawings diagrammatically in view of the full and complete showing of this type of gear box in United States patent to McFarlane et al. No. 1,754,688, April 15, 1930.

The shaft 2 extends through the gear box 6 and carries on its other end a second drum 8 around the surface of which is wrapped the material to be operated on by the impression tool and preferably this material comprises a stereotype mat where the material is to be used as a casting matrix.

An interrupter disc 9 is mounted on a shaft 10 connected with the gears in the gear box whereby the disc 9 is rotated when the shaft 2 rotates. The disc 9 is a metal disc provided with a plurality of separate insulating areas 11.

A source of light 12 is adapted through optical means 14 to concentrate a spot of light on the drum 1. The reflected rays from this scanning spot are collected by a lens 15 and delivered to a photo-electric cell 16 which is connected with an amplifier 17. The amplifier 17 preferably is connected with a filter 18 to eliminate any distortional waves and the filter 18 is connected with a power amplifier 19 which leads to the operating device 20 for the impression tool 21. It is to be understood that suitable sources of electrical current, such as batteries, generators, etc., are provided to supply the necessary current in the circuits specified. A pair of brushes 22 and 24 are connected in the circuit with the disc 9 in such manner as to produce a definite interruption or substantial oscillation at predetermined intervals in the main circuit. Preferably, these brushes are connected into the circuit in the first amplifier. The brush 22 bears upon the continuous contact surface of the disc 9 while the brush 24 bears upon the portion of the disc including the insulating areas 11 so that as the disc is rotated, the brush 24 intermittently makes and breaks the circuit in the brush line connection. This arrangement is for the purpose of producing an interrupted or oscillatory current and the gear connections between the shaft 2 and the shaft 10 carrying the disc 9 is such that a predetermined definite number of interruptions will occur in a predetermined angular movement of the shaft 2 so as to provide a definite number of operations of the impression tool 21 when a predetermined distance on the drum 8 has passed beneath the tool. In other words, this relationship of the interruption of the current to the rotation of the shaft 2 determines what is known in the art as the "screening" of the reproduced picture. It is to be understood that this oscillating current may be obtained by other mechanism and devices known in the art.

The operation will be more clearly understood from a consideration of Fig. 13 which shows a suitable circuit for amplifier 17 and suitable circuit connections thereto from interrupter 9 and photo-electric cell 16. The interrupter is shown connected to the input side of amplifying tube 50, but it may be connected to the output side of the tube. In either case, it causes a pulsating direct current to flow in the primary of transformer 51, the frequency of the pulsations being the same as the frequency of the interruption. Suppose that there be sixty interruptions per second, which is a practical figure. Then there will be sixty direct current pulsations per second in the primary of transformer 51 and sixty alternating current pulsations per second in the secondary of the transformer, the conversion from direct current to alternating current being due to the well known induction principle on which transformers operate. At any given instant, the magnitude of the flux in the core of a transformer is governed by the magnitude of the primary current and the instantaneous voltage induced in the secondary is governed, not by the magnitude of the flux, but by the instantaneous rate of change in the magnitude of the flux. Also the instantaneous direction of the secondary current (i. e., either positive or negative) is determined by the instantaneous direction of the flux change, i. e., whether the flux is increasing or decreasing. Thus, during that part of a direct current pulse in the primary winding during which the current is increasing, the core flux is increasing, and a secondary voltage in one direction is being induced. Then, during that part of the direct current pulse when the primary current is decreasing, the core flux is decreasing and a secondary voltage in the opposite direction is being induced. Thus a pulsating direct current in the primary produces a true alternating current in the secondary.

The effective frequency (or frequencies) of an alternating current as far as circuit functioning is concerned is the sine wave frequency of the current, a pure frequency being one single sine wave. The interrupter 9 produces an abrupt chopping effect with the result that the direct current pulsations (assumed to be sixty per second) in the primary of transformer 51 are not sinusoidal in form. Correspondingly, while there are sixty reversals of current per second in the secondary, the secondary alternating current is not a sine wave. However, any non-sinusoidal alternating current wave (no matter of what shape) is a mathematical composite of a plurality (often a great multiplicity) of pure sine waves of different frequencies. And the current in the secondary of transformer 51 is a composite of sixty cycle current plus a number of higher frequencies. Accordingly, it is passed to filter 18 which eliminates (or greatly reduces the magnitude of) the component current of higher frequencies.

The filter may be any one of a number of cir-

cuits used in the art for such purposes. An example is a conventional low pass filter shown in Fig. 10, the sixty cycle current passing from the input to the output of the filter and the currents of higher frequencies being shunted through condenser 52. Other filter circuits which may be used are conventional band pass filters shown in Figs. 11 and 12. The series sections A offer little opposition to currents at or near the frequency to be passed (e. g. sixty cycles) but offer great impedance to currents of higher and lower frequencies, while the shunt sections B offer great impedance to the frequency to be passed and very low impedance to higher and lower frequencies.

Any suitable power amplifier may be used at 19. In Fig. 14 there is shown the circuit of a suitable commercial amplifier which applicants have used for the purpose. No description of this circuit is necessary since it is the manufacturer's drawing of the amplifier used, being one made by the American Transformer Company.

Fig. 2 illustrates a preferred form of operating mechanism for the impression tool. This preferred form comprises a cup shaped magnet 25 carrying a central core 26 provided with an opening 27. This magnet is supplied with a suitable coil 28 adapted to be energized by direct current and comprises the field coil for the magnet. An armature coil 29 is mounted upon the impression tool 21 and this armature coil 29 is adapted to be energized by the oscillating current from the power amplifier 19. Preferably, a guide shoe 30 is provided for the head of the impression tool 21 so that the tool is accurately guided in its reciprocating motion. The guide shoe also bears against the mat on the drum 8 and holds the mat in position on the drum.

Preferably, the arrangement of the circuit is such that the armature coil 29 is intensely and quickly energized and then the energy is momentarily reversed, so that the tool is driven forward with a force dependent upon the energy of the current established through the photo-electric cell and the reversal of the current very quickly withdraws the tool. In this way, the mat on the drum 8 is subjected to quick, sharp impacts of the pointed end of the impression tool 21, which pointed end is forced into the mat in accordance to the strength of the current as determined by the effect of the scanning spot on the photo-electric cell 16. In this way, a replica of the original picture is reproduced on the mat by impressions of varying depths produced by the point of the impression tool.

The operation and result of the impression tool are illustrated in Fig. 3 in which the lightest tones are indicated by the shallow impressions 31 whereas the blackest and darkest tones of the original picture are reproduced as the deep impressions 32 and the intermediate impressions 34 indicate an intermediate tone. In carrying out one method of the present invention, the mat 35 carrying the impressions is utilized as a casting matrix and a plate similar to a stereotype plate is cast against this mat. The result is a casting 36 illustrated in Fig. 4, the face of which casting comprises small cones 37 from the shallow impressions 31, large cones 38 from the impressions 32, and intermediate cones 39 from the intermediate impressions 34. Preferably, these cones are reduced to the level of a plane 40 in Fig. 4. This reducing operation may be performed by pressure of a flat hard surface against the ends of the cones above the plane 40, causing the metal therein to slightly expand the diameter of the cones and to produce flat surfaces on the tops thereof. Preferably, the line 40 is above the tips of the smallest cones 37 so that the cones representing the dark portion of the picture terminate as frustums of cones above the small cones. This is particularly desirable in newspaper work and obviates the necessity for bumping, make ready, or underlaying.

Figs. 5 and 7 illustrate a final printing plate resulting from the foregoing method and in which printing faces 41 are formed on the cones while the tips of the cones 37 of themselves are printing faces for the high lights of the printed impression.

Where the device is to be used to make a printing plate of the "Roto-gravure" type, such a plate is formed directly from the operation of the impression tool. In this case, the impression material may be suitable material such as soft copper, zinc, aluminum or other material which of itself is adaptable as a printing face. Preferably, where the device is to be used to reproduce "Roto-gravure" plates, the point of the tool is blunt, and the effect is obtained largely by the depth of which the tool is forced into the plate, thereby forming cupped recesses having ink holding capacity of various amounts, thereby corresponding to the light and shade tones of the picture; that is, where the picture unit area is light, a very shallow cup will be provided and where a picture unit area is dark, a deep cup will be provided.

Fig. 8 illustrates a section through a row of ink cups of a printing plate made according to the present invention and adapted for "Roto-gravure" printing. In this form of plate, the impression tool has a blunt point 42, which is impacted a greater or lesser depth into the printing plate 44 to produce deep ink cups 45 for dark unit areas, and shallow ink cups 46 for light unit areas.

The construction wherein the shaft 2 extends through the gear box 6 results in a matrix mat that produces a cast when finished that prints a positive, i. e. a replica of the original. Where the device is used to produce "Roto-gravure" plates from which printing is done directly, preferably a second lead screw 2^a (Fig. 9) is provided to carry the drum 8, and this lead screw which may be threaded oppositely to the screw 2, causes the drum 8 to move axially opposite to the axial movement of the drum 1. This results in a printing face being made on the drum, which face will print directly replicas of the original.

It will be noted the present invention provides for making a printing member directly from an original without the usual steps of photography, etching, etc. This results in a great saving of time which is particularly important in newspaper work. It also results in economies in many ways whereby a relatively expensive step in the printing art is greatly reduced in cost.

The term "Roto-gravure" used in this specification is intended to refer to any type of intaglio printing plates regardless of whether used on a rotary, cylinder, flat bed or other type of printing press.

The word "original" used in this specification and claims is intended to cover any kind of two dimensional representations, e. g. photograph, print, drawing, painting or lithograph or others.

What we claim is:

1. A device of the class described comprising a drum carrying an original, a second drum

carrying a work plate, a reciprocating punch impression member, means to scan the original and produce an alternating electrical current which varies in accordance with the light and shade of successive elemental areas of equal size along a scanned line on the original, and means to operate said reciprocating punch impression member in response to said current to indent said work plate whereby each indentation represents an elemental area on the original, said current controlling the operation of said punch member to cause the depth of said indentations to be in accordance with the light tone of the corresponding elemental area on the original and the reversals of current quickly withdrawing the impression member from engagement with the work plate.

2. The method of making a continuous tone matrix from, and corresponding to, a continuous tone original which comprises; successively producing power impulses corresponding to the tone values of successive elemental areas of the original; and punching, in the matrix, cuneiform indentations varying in depth with said tone values by applying the power impulses successively to a pointed punching tool.

3. The method of making a matrix from and corresponding to an original which comprises scanning the original and successively producing power impulses corresponding respectively to the tone values of successive elemental areas of the original; and punching, in the matrix, cuneiform indentations varying in depth with said tone values by applying the power impulses successively to a pointed punching tool, while between power impulses shifting the relative position of the punching tool and the matrix by an amount corresponding to the size of the elemental areas of the picture.

4. The method of producing a printing member comprising forming a surface studded with small upstanding projections of different heights and of different sized bases, the heights of said projections corresponding to light tone values of elemental areas of an original, applying a pressure member having a flat hard surface to the ends of the long projections, and applying pressure to said pressure member to flatten said projections and slightly expand the diameter of said projections to produce flat surfaces on the tops thereof to provide a printing member having the flat ends of said flattened projections lying in a predetermined plane and with the flat top areas of the ends of said projections corresponding to light tone values of the original.

5. A device of the class described comprising means carrying an original, a support carrying a work plate, optical means to concentrate a spot of light on said original to cause light to be reflected therefrom, means to cause said spot of light to scan said original, photo-electric means to vary a direct electrical current according to the amount of light reflected from the said original as to each unit area thereof, means to produce an alternating electrical current from said direct current, the alterations of said alternating current being directly controlled by the means which causes the spot of light to scan the original, and a freely movable reciprocating punch member operated by said alternating current to permit the full force of said punch to be delivered against said work plate.

MAYNARD D. McFARLANE.
GABRIEL KINN.