

Jan. 28, 1936.

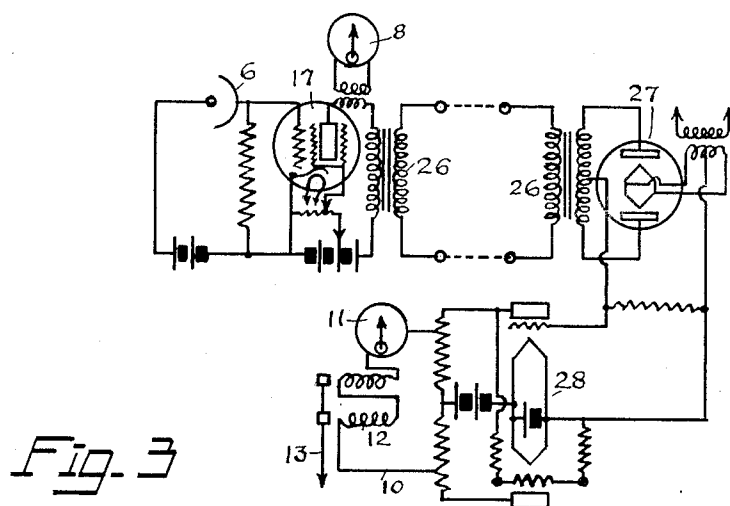
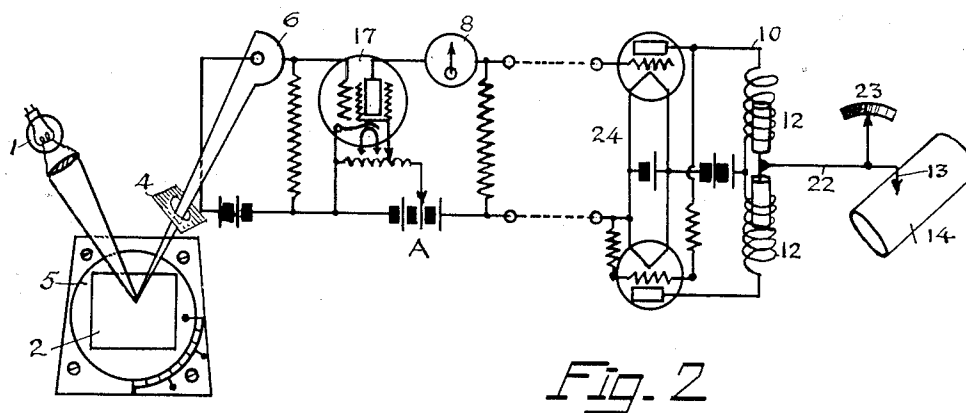
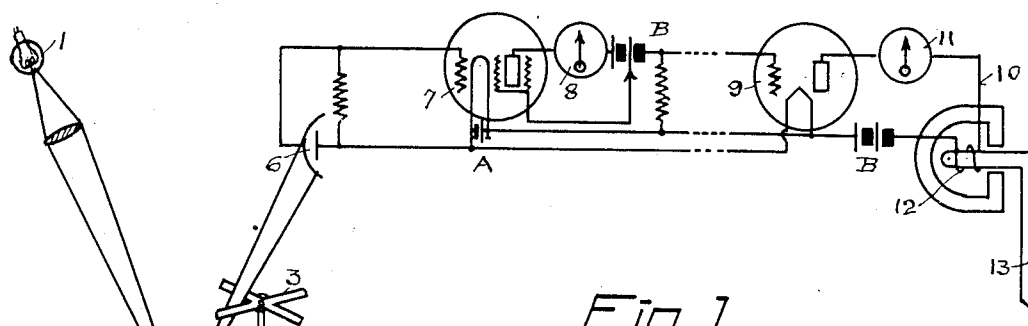
W. HOWEY

2,029,103

PHOTO-ELECTRIC INTAGLIO AND RELIEF ENGRAVING SYSTEM

Filed March 15, 1932

2 Sheets-Sheet 1



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2 Sheets-Sheet 2

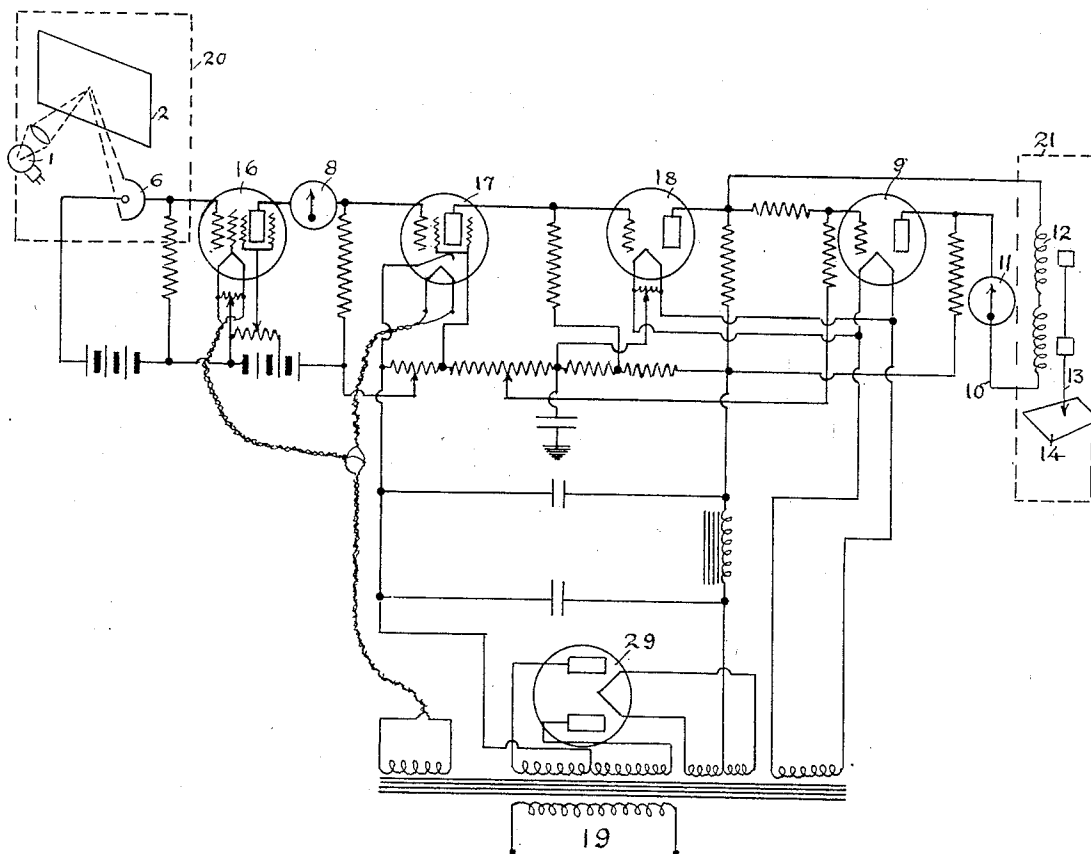


Fig. 4

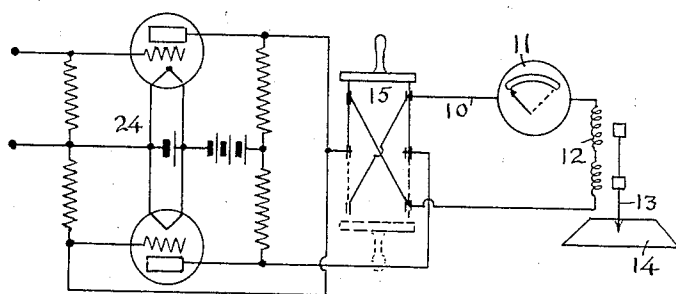


Fig. 5

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2,029,103

PHOTO-ELECTRIC INTAGLIO AND RELIEF
ENGRAVING SYSTEM

Walter Howey, New York, N. Y.

Application March 15, 1932, Serial No. 599,034

2 Claims. (Cl. 178—5)

My invention relates to a photoelectric intaglio and relief engraving system and it more especially consists of the features pointed out in the claims.

5 The purpose of my invention is to provide an engraving system that is equally suitable for producing intaglio and relief printing plates in color, suitable for textile or other printing; that auto-
10 matically produces rotogravure printing plates; and the like and also produces embossing plates; that employs features of transmission and ampli-
15 fication which make possible the production of engraving at the point of transmission or at a distance therefrom; that also makes possible the
20 engraving of bas-relief or three-dimensional surfaces from shaded subjects which have only two dimensions of area comprised in width and
length; that provides for the automatic engraving in relief or intaglio of embossing surfaces
25 from any desired subject without resorting to manual manipulation; that avoids the preparation of a master and a duplicate die for embossing with its complicated steps that call for staging or processing and the use of expert hand
labor; that through the system or process herein described the production of engraved plates is made entirely automatic.

30 This is a continuation in part of my application Serial No. 424,809, filed January 31, 1930, which on March 15, 1932 matured into Patent No. 1,849,544.

With these and other ends in view I illustrate in the accompanying drawings such instances of adaptation as will disclose the broad underlying
35 features of the invention without limiting myself to the specific details shown thereon and described herein.

Figure 1 is a diagrammatic view of the related electrical circuits in Fig. 2 of my Patent No.
40 1,849,544, issued March 15, 1932.

Fig. 2 is a diagram of an alternative electrical circuit using vacuum tubes in push-pull arrange-
45 ment and showing means for rotating the copy at various degrees to prevent moire effects in the engraving.

Fig. 3 is a diagrammatic view of yet another alternative electrical circuit, showing the use of transformer coupling to amplify the modulated
50 carrier frequency generated by a tone wheel or other source of alternating or pulsating current.

Fig. 4 is a diagram of a complete electrical circuit, showing the use of a well known form of direct resistance coupled amplifier coupled to a
55 photoelectric cell which in the output of the push-pull tubes has an inductive magnetic engraving

device. It also shows a unit power system which makes the self-contained unit operative by simply plugging into an alternating source of current.

Fig. 5 is a diagrammatic view of a reversing switch and its related circuits, by means of
5 which, from the same subject, an intaglio or relief engraving may be produced at will.

In utilizing my system I may employ whatever alternatives or equivalents of structure or cir-
10 cuits that the exigencies of varying conditions may demand without departing from the broad spirit of the invention.

Any desired subject is mounted for scanning by a photoelectric cell and associated amplifying
15 means. A material adaptable for ultimate embossing or printing is mounted on a suitable support to be engraved. The output leads from the amplifier to the engraving head are so arranged that when black or absence of light is scanned
20 by the photoelectric cell the magnets of the engraving motor will cause the engraving tool to miss the surface. When white is encountered the tool is caused to cut deeply into the surface and
when gradations of tone or variations of light and shade are scanned the motor magnets will defi-
25 nitely and positively hold the tool at different depths to remove varying areas from the surface so as to cut a master die corresponding to the details of the subject.

To produce a mother or intaglio die the en-
30 graved master plate is removed from its mounting and an unengraved plate or roll is substituted for it. The synchronous scanning head
20 or cutting and engraving head 21 are moved to the starting point and at one edge of the subject
35 2 and the receiving plate 14 the leads from the amplifier to the cutting head 21 are reversed in any suitable manner by a well known reversing
switch 15 or the relative movement of the en-
40 graving tool 13 may be reversed in any suitable manner by changing the fulcrum of its operating lever 22 so that when black is encountered in
scanning, the engraving tool would cut deeply into the surface and when white is encountered
45 the graver will miss the surface and when gradations of tone are encountered the tool will en-
grave with reversed relation to that of cutting the master plate. For the engraving tool 13 used
in the process of cutting the master plate a second graver may be substituted for cutting the
50 multi-plates to provide for better registry of master and mother dies in embossing or printing and embossing. A simple method of bringing
about the reversing action for cutting relief, or cameo, or intaglio engravings, referred to above,
55

of the same subject, a double pole double throw switch 15 is placed in the output of the amplifier leads. However I do not confine my invention to this method of securing a reversal from one type of result to another as any other system, mechanical or electrical, may be employed.

The invention is directed to the reversal in scanning a subject to engrave master or mother die replicas without recourse to manual manipulation or the introduction of reversal as practiced in picture transmission by telephone or radio so as to change a positive to a negative or vice versa.

My process lends itself readily to the rapid and economical preparation of dies for die sinking stamping purposes to produce repetitions of designs, in relief or intaglio for striking medals and the like.

Substitution of engraving tools of variable area or shape in the alternating process of engraving and embossing master and mother dies permit of accurately engraving dies for embossing materials of varying degrees of thickness and this is a feature of the invention. In my application Serial Number 424,809 and on Figs. 2 and 3 there is shown an output meter 8 for observing the depth of the engraver. This method of regulating depth may be utilized in combination with the use of engraving tools of various shapes and cutting area. It also provides for great accuracy in engraving and mother dies for use in embossing materials of varying degrees of thickness. To simplify the work of embossing a heated tool may be used. This tool may be heated in any suitable manner.

In Fig. 2 is shown an improvement over the circuit of Fig. 1. Here a light 1 is shown focused on a piece of copy 2 from which it is reflected to a photoelectric cell 6 through a filter 4. The current generated by the photocell 6 is amplified by a sufficient number of stages of vacuum tube amplification 7-9 to cause it to control the output of the power tubes 24 arranged for push-pull operation. In the plate circuits of the power tubes 24 are the actuating coils 12 of the magnetic engraving device, or cutting head 21. The armature 25 associated with the coils 12 and the lever 22 is pivoted so as to cause the tool 13 to cut into the metal to depths corresponding to the intensity of the light reflected to the photocell 6 from the copy 2. An indication meter 8 in the plate circuit of the first tube 7 of the amplifier indicates the operating output of that tube which controls the further amplification of the rest of the circuit. An indicating device in the output of the amplifier or an indicator 23 mechanically controlled by the engraving lever 22 will show the tones that are being engraved at any instant. The holder 5 for the copy 2 is arranged (Fig. 2) so that it may be rotated for each successive scanning in case of color separation work, where more than one scanning is made of the same copy. This is to avoid a moire effect which arises from the interference of parallel lines when two cuts occur at acute angles to each other. The copy is rotated 30 degrees or more from the original or first scanning and it is then again scanned at other angles, to produce a second and a third engraving. When the engravings are printed successively, one impression on top of the other, a pleasing composite effect is secured without any interference of the two sets of lines that otherwise would produce an incongruous or moire effect.

It will be understood that the dotted lines in the

electrical amplifying circuits of the different figures may represent any number of stages of amplification which may be coupled in any form or manner.

In Fig. 3 is shown a variation of the electrical circuit, in which transformers 26 are used to couple the first stage 17 and subsequent stages of amplification and a rectifier 27 is used to provide direct current for controlling the push-pull output tubes 24. Any of the well-known means of introducing recurring impulses into the photoelectric circuit may be used, such as by a transformer in the photocell circuits or by a tone-wheel 3 to break up the light before it reaches the cell 6. This is sometimes called a light chopper. Sources 19 of a conventional A. C. current may be controlled by a tuning fork of the proper frequency or a vacuum tube oscillator.

The dotted lines, as already mentioned, in the amplifying circuit may represent any number of amplifying stages 7-9, 16, 17 and 18. The filament of the rectifier tube 27 may be excited by alternating current as shown or by direct current as desired. The rectifier may be of any type such as a copper oxide rectifier or a gaseous type tube rectifier. In this circuit, Fig. 3, a reverse current hook-up 28 is shown in place of the standard push-pull in the circuit of Fig. 2. That is, although the current flowing in the resistors in the plate circuit of the power tubes flows only in one direction for each tube, the current in circuit 10 and in the coils 12 of the engraving head 21 reverses when the flow of current is transferred from the plate circuit of one tube to the other. The reason for this is that the current flowing in one resistor is diametrically opposite that flowing in the other resistor.

When equal current flows in both resistors, there is no current flowing in the coils of the engraving head and the armature is held in the center of its total swing by the combined forces of the two opposing magnetic fields of the device. It will be understood, however, that the standard push-pull circuit may be substituted for the reverse current circuit without departing from the broad scope of the invention.

A diagram is shown in Fig. 4 of a complete unitary circuit with its power supply 19, 29 for the photoelectric engraving machine as an independent and complete unit. The amplifying circuit 16, 17, 18, 19 is especially adapted to amplify with equal fidelity direct current and alternating current of any frequency encountered in the engraving process. Since, without the use of special means for introducing alternating components or carriers into the circuit, the currents to be amplified are direct currents of various amplitudes. This feature is of prime importance. At times the current generated in the photocell 6 may be of unchanging amplitude for a considerable time and at other parts of the picture the amplitude of the current may vary at the rate of from four to six hundred times a second.

The source of rectified high voltage and alternating current filament supply is shown as a well known form of power output associated with its accompanying rectifier and filter circuits. Any other form of power supply circuit may be used which is found to be better from the standpoint of more perfect rectification and filtration without departing from the broad spirit of the invention.

The method of reversing the action of the engraving device to cause it to engrave intaglio

printing plates or embossing plates or relief printing plates from the same subject as is used for engraving a relief plate is shown in Fig. 5. The plates of the two push-pull power tubes 24 are connected to a reversing switch 15, so that when the switch is thrown in one direction the current will flow in the circuit 10, the ammeter 11 and controlling coils 12 of the engraving device in one direction and in the reverse direction when the switch is changed over.

By the use of this switch, it is possible to engrave a relief plate from either a positive or negative subject or an intaglio plate from the same. This is the simplest form of reversing mechanism it is possible to incorporate in the output of an amplifying system. Other means such as employing a phase reversal tube are complicated and do not serve the purpose any better.

In my patent application, Serial Number 424,809 there is shown and described a method for making engravings from continuous tone subjects suitable for relief or offset printing. My present process however provides for the engraving of plates suited for printing continuous tone copies of a continuous tone subject. A blunt tool may be substituted for a tapered tool and a screen (not shown) interposed between the subject 2 and the photocell 6 in the scanning system so that the action of the screen in intercepting the light reflected from the subject will cause the tool 13 to cut an intermittent series of indentations of constant area but varying depth into the surface of a substance suitable for printing.

This substance may take the form of a plate or a roll, similar to the rolls used in rotogravure printing. The interrupter may take the form of the screen, as above outlined, or any other suitable method of interruption.

Tone, in photography, designates values of light and shade; in music or radio it represents values of frequency. In photography, a picture is referred to as having a continuous tone, to differentiate it from well-known, so-called, half-tone-screen-line reproductions produced by relief or offset printing. An ordinary half-tone presents an optical illusion of tone, although it may be printed on white paper with black ink, in the form of innumerable almost microscopic dots of varying area and separations and uniform pitch. A continuous tone picture, such as a photograph, painting, or gravure reproduction of the same, when scanned with a photoelectric cell and associated amplifying system may set up no cyclic frequency. The current modulation of the photocell circuit, during the process of scanning a photograph, is a modulation of amplitudes. These surges of direct current may be faithfully amplified by a direct current amplifier, such as has been indicated in my application Serial Number 424,809.

In telephotography or radio photography, it is customary to modulate a carrier wave with the picture amplitudes for purposes of transmission. In photoelectric engraving such as has been described in Pearne et al. Patent No. 1,719,621, modulation of the continuous tone components of a photograph may be found desirable, in which case the amplifying system may comprise transformer or other suitable coupling, however the amplifier output may be made as indicated by Fig. 1, of this application, to secure improved results.

A uniform modulation of the characteristics of the scanning may be set up by any one of the following methods: (a) interruption of the light

beam; (b) of the amplifier; (c) of the carrier; (d) periodic interruption of the reflection characteristics of the subject. The first three methods are well understood in picture transmission. Method (d), well known in the photoengraving art, may be used by interposing a ruled transparent screen, similar to a photoengraver's screen, between the subject and the photocell to interrupt the reflected or transmitted light. The screen may be of the cross line variety. It may be ruled in parallel lines only, set at a suitable angle so that the ruled lines and the aperture frame of the photocell or its diaphragm will cause frequency interruptions during the process of scanning. The screen may be of the metzograph type with minute irregular optical gradations. The screen formation may take any design found suitable in ordinary photoengraving, and the screen separation characteristics may be imparted to the subject to be engraved by first photographing it through a screen or by using a proof of a half-tone photoengraving of the subject. However interposition of a ruled screen between the subject and the photocell makes the latter involved processes unnecessary. Any of the methods described may be used to impart to the carrier or amplifier a uniform frequency modulation suitable to photoelectric transmission or engraving purposes. This picture frequency modulation in turn may be used to modulate a high frequency carrier wave with the provision of means for rectification in the receiving amplifier.

In addition to the forms of periodic interruption above outlined, the interruption may be confined to the engraving head, and it may be introduced in the form of a magnetic interrupter described in U. S. Patent No. 1,719,621, or it may be produced mechanically. I do not limit myself to any one prescribed form of interruption in the practical production of engraved plates in an automatic manner.

As photo or rotogravure printing does not depend for its effect upon the optical illusion of ordinary half-tone dots, it is obvious that the indentations of constant area and varying depth, in a printing surface, will on a gravure press equipped with fountains and rolls for distributing ink over the entire plate and a "doctor" for scraping the surplus ink from the surface of the plate, transfer to a printed sheet dense ink from deep indentations and less dense pigmentation from shallow indentations. I accomplish this by my rapid automatic photoelectric method of engraving continuous tone printing surfaces, which is a radical improvement over the highly complicated manual process referred to.

As my process of color engraving described in my application Serial Number 424,809 does not readily lend itself to transmission at a distance by reason of the inherent losses attendant to direct current transmission, my present invention makes possible transmission of color separation or continuous tone images, and the engraving of plates suitable for printing direct therefrom without the employment of an aperiodic amplifier.

In U. S. Patent No. 1,719,621, was shown a method for making engravings having a frequency characteristic, such as the discontinuous half-tone dot, common to a relief picture printing block. This method, obviously, could be applied to the engraving of black and white line work. Half-tone engravings might be made indirectly by inserting a low frequency chopper 3 between the subject 2 and the photocell 6, or by 75

inserting a one or two way ruled transparent screen, similar to a half-tone screen between the subject 2 and the photocell 6, or by introducing some cooperating means of periodic interruption into the photocell or the amplifying circuit, or by causing the cutting tool 13 to rise and fall intermittently by mechanical or other means. A screened half-tone negative might be used for scanning or as an alternative a positive print, containing the separation dots, might be made by the silver print or velox method from the half-tone negative and this print in turn be made the subject for scanning. In the Pearne et al. patent referred to, transformer coupling was employed. Consequently some one of the above methods became necessary to provide transformer coupled amplification to obtain sufficient power to do the engraving.

The employment of such processes to break a continuous tone subject into discontinuous pulses, having a frequency characteristic are commonly employed in various methods of picture telephony and telegraphy by wire or radio and it is standard practice for a different purpose, that of transmission. It is easier to transmit variations in frequency, either directly or through carrier current modulation than it would be to transmit variations of amplitude only, without frequency modulation.

This practice has lead to the misconception of a photograph, painting, or other subject having continuous components of light and shade as also comprising a so called picture frequency. Actually, as expressed in terms of a photoelectric current, during the process of scanning a photograph, there may be no cyclic frequency but only a series of varying pulsations in amplitude, corresponding somewhat to light as defined by the

quantum theory. My invention does not, however, concern itself with the wave or quantum theories of light, but it is inherently directed to means for photoelectrically producing engravings suitable for the production of prints of continuous tone subjects from picture transmissions, either as a gravure or rotogravure, which for purposes of modulation, amplification or transmission, may have been given a frequency, discontinuous or dot or line characteristic.

What I claim is:

1. A photo-electric engraver comprising a light sensitive scanner, a vacuum tube amplifier adapted to increase the strength of the output of the scanner, a graver, an actuating arm therefor, a bi-polar armature on the arm spaced apart from the graver, a separate coil for each pole connected in opposition to each other, a push-pull amplifier comprising a pair of amplifier tubes actuated by an amplified current from the scanner, connections from one coil to the plate of one of the push-pull tubes, and connections from the other coil to the plate of the other push-pull tube, and cooperating means for indicating the successive positions of the graver.

2. The method of photo-electrically engraving a pictorial subject, consisting in photo-electrically scanning a subject and engraving a surface in synchronism, in amplifying the output of said scanning, in causing said amplified output to control a magnetic engraving device, and in adjusting the static characteristics of the amplifier to control the zero position of the engraver prior to the photo-electric scanning, to cause the depth of engraving to be in accordance with the variations of the photo-electrical scanning of the subject.

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