May 23, 1933. V. C. ERNST 1,909,939

ADJUSTABLE PHOTOGRAPHIC PRINTING APPARATUS

Filed Nov. 29, 1927 2 Sheets-Sheet 1

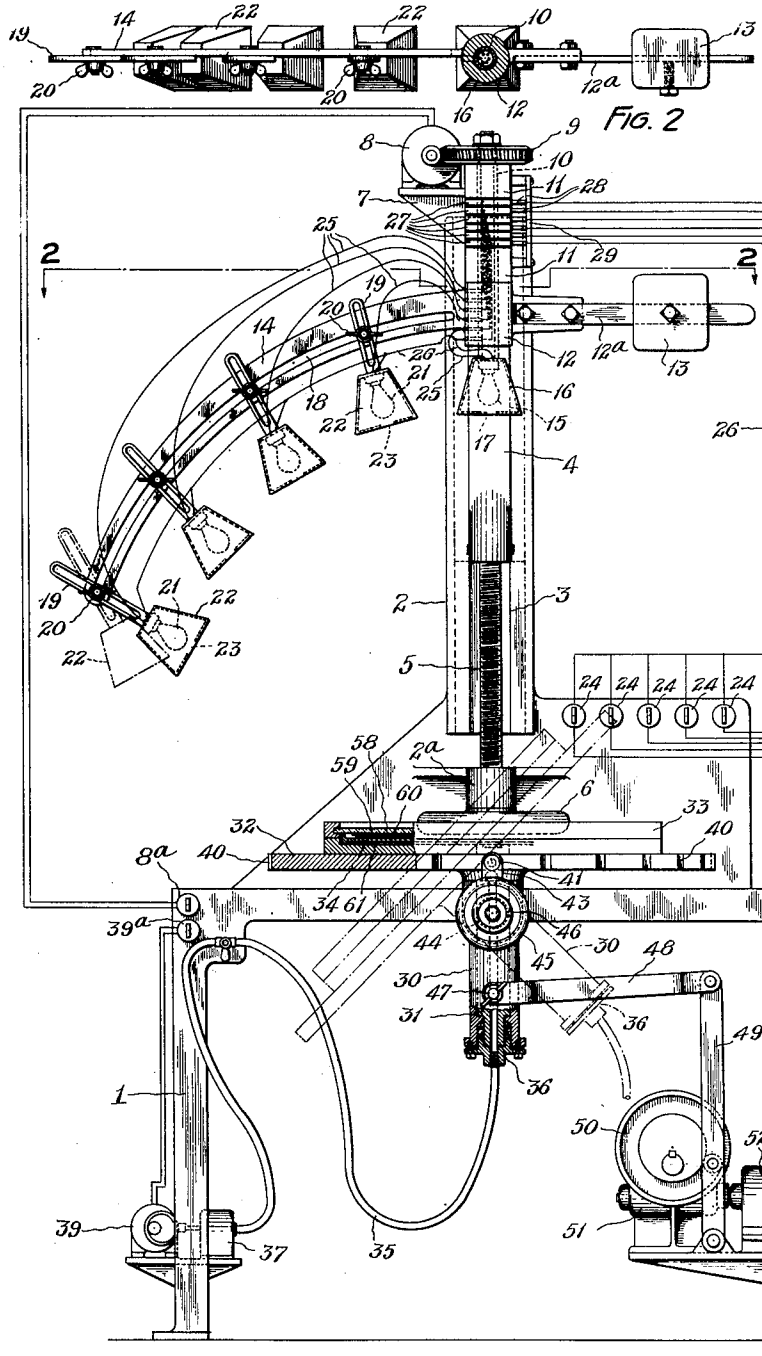


FIG. 1.

FIG. 2

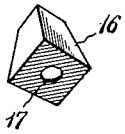


FIG. 3.

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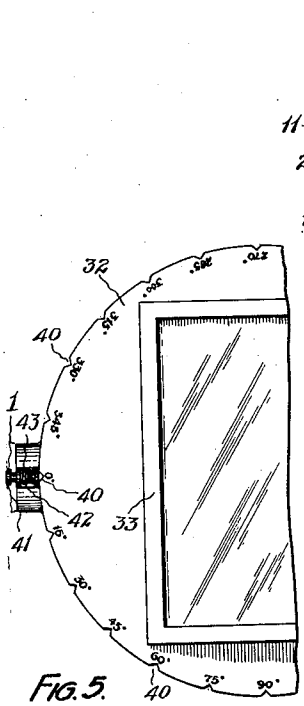


FIG. 5.

FIG. 4

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UNITED STATES PATENT OFFICE

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ADJUSTABLE PHOTOGRAPHIC PRINTING APPARATUS

Application filed November 29, 1927. Serial No. 236,445.

My invention pertains to adjustable photographic printing apparatus and is particularly applicable to commercial production of printing plates whether adapted to photolithography, rotogravure or photo-engraving.

The present invention marks the further progress of my experiments with the aid of the discoveries shown, described and claimed in my Patent No. 1,849,036 of March 8th, 1932 and in my co-pending application Serial No. 199,842 filed June 18, 1927.

I have discovered the possibility of realizing and practically perfected the realization of an infinite number of tonal variations alike in the production, for instance, of black, white and all the intermediary shades or tones without dependence upon any particular style or formation of lensic screen. I achieve infinite tonal gradations or variation by effecting one or more of several changes, adjustments or movements of units of the photographic apparatus. In some instances the relative adjustment or movement will be successive or intermittent and in still others continuous. The overlapping image recordation by projection, as explained in application Serial No. 199,842, is of pronounced value in the production of high lights, but I have further discovered that that advantageous result may be accomplished irrespective of the principle of truncated more closely arranged lenses. The same result of overlapping recordations or interlapped light affected areas may be achieved by relative adjustment or motion between certain parts of the projection apparatus or printing frame. I may either vary the size of the aperture from which light is emitted or projected, or I may vary the shape of the opening through which light is projected, or I may vary the distance between the source of light and the printing frame, or I may vary the shape of the incandescent filament, or I may vary the angle which the axis of the light beam forms with the optical axis of any particular microscopic lens either by adjustment along a straight line or along an arcuate path.

It is manifest that there is a demand for absolutely perfect tonal reproduction of the lights and shadows of an object of which a printing plate is to be made, usually involving use of a photograph. It is readily perceivable that such reproductions, if independent of human control with its factor of likelihood of error either of judgment or accident, will be made to approach absolute perfection if the recordations are caused to be accomplished in what may be termed an "optically automatic" manner, excepting only such alterations of tonal results which experience teaches to be required in order to rectify either for illusions to which the human eye can be subject or for unavoidable imperfections in the final printing operation.

The method of use consists in first obtaining a photographic continuous-tone negative of the object or picture which it is desired to reproduce. To realize an economy of manufacture and convenience, the sensitized emulsion may be deposited on the flat side of the lensic screen and the continuous-tone negative of the object or photograph becomes preserved on the emulsion coating of the screen. If a negative is possessed, it is placed in juxtaposition to one side of a lensic screen during contact printing when light rays are projected toward the plate and intercepted by the lens conformations of the screen to be refracted thereby through the negative image which is at the opposite side of the lensic screen; whereas, during projection printing (enlarging or reducing), the light rays are allowed first to pass through the negative photographic image and then through the lensic screen to the light-sensitized surface.

Assuming an artificial source of illumination to be employed during the printing operation, for instance, an electric lamp together with a reflector, the size of the aperture through which the light rays pass may be varied to change the size of dot and sometimes to compensate for what is known in the art as "spreading" due to over exposure or enlargement of the light-affected area of the sensitized element beyond the theoretically expectable pattern boundary; or the shape of the aperture may be varied to alter the re-

corded microscopic pattern; or the distance between the lamp and the printing frame may be varied to correspondingly enlarge or reduce the image recorded by refraction; or the angle which the line, along which the light rays center, makes with the receiving surface of the printing frame may be varied whereby both bodily to shift the refracted image from its optical center position and to alter the shape of the recorded image or pattern and lastly, a relative turning action (arcuate adjustment or rotation) may be effected while light rays are excluded from a central portion of any particular microscopic lens element whereby to record duplicated patterns circularly arranged or an annular pattern respectively.

For example, in rotogravure work it may be elected to employ square pattern dots, in photo-lithography crosses instead of the conventional round dots and in photo-engraving round dots or in any one of the three any one of an innumerable list of patterns including lines extending in any direction, zigzags, diamonds, elipses and lenticular combinations.

Heretofore, so far as my knowledge extends, printing plates have comprehended only three tonal values and the microscopic dots thereon while of different size were uniform in shape. True tonal reproduction can not be obtained by reliance, as heretofore, merely upon three tones, namely, high light, middle tone and shadow. It has been attempted to improve upon the optical deficiency of only three tonal values, by mechanical juggling and manipulated artistry which are laborious and time consuming. That the best printing plates till now produced have been far from perfect tonal reproductions is evidenced by the noticeable degree of visual change or perceptible loss in quality upon enlargement, as for instance, from an 110 (to the inch) line screen to a 55 line screen in newspaper work. In consequence of the recognition of that, all engravers prefer to reduce so as to be certain not to lose tonal values. It is the present practice to use matrices and they are continually mailed for employment as a mold for a printing plate, but it is an established fact that tontal values are lost in drawing a paper matrix from a plate and necessarily again lost in making a plate from the matrix.

As contradistinguished, my invention permits production, as a new article of manufacture, of a printing plate in which many more tonal gradations of an object are automatically reproduced so that a far more nearly perfect screen print may be obtained, characterized by having dot patterns of different shape, or elements of the microscopic dot pattern of different formation to produce what may be termed a blended dot variation corresponding to the tonal contrast of the original object. My invention improves, yet quickens and cheapens the entire process of printing plate manufacture. Screen prints, made according to my invention, may be mailed to a customer instead of matrix plates to involve greater convenience, less time in their use, less mailing cost and reproduction of metal plates without noticeable loss in tonal value or quality. My screen prints or paper positives may be directly rephotographed or printed to provide a pictorial negative on metal with all the dot blending reproduced. It is possible with my invention to print a photographic paper as a positive screen or to supply a photographic film or plate as a transparent positive through which either to project to enlarge or reduce or through which to print directly on an emulsion coated metal plate. Then after etching, a printing plate is provided. Having a print from what may be regarded as a continuous tone positive, I can obtain a negative either on paper, film or metal. A further feature of my invention is my method of displacing dot recordations from an optical center position which is of particular value in jobs done in different colors. That is, the image recorded through any particular microscopic lens is displaced laterally from the point where the axis of the lens intersects the focal plane. For instance, in producing a job involving the three primary colors and black, the projection lamp may be mounted so as to shed its rays obliquely toward the printing frame and the latter successively turned through arcs of 90° whereby elliptical dots are successively recorded offset or displaced at a different one of the four points of the compass on four distinct plates respectively, and thereafter each differently displaced group of the four elliptical image recordations, one on each of four plates and composing a particular compass-displaced dot pattern, are employed to print one of the four colors.

It is to be realized that the scope of my invention comprehends many equivalent methods and constructions. The showing of the drawings and the particular description are merely specific exemplifications of a plurality of successful mechanical embodiments, arrangements and performances.

Adverting to the drawings:—

Figure 1 is a front elevation of the improved apparatus used for manipulating the printing frame in carrying out this improved process for making printing plates.

Figure 2 is a fragmentary plan section taken on line 2—2 of Figure 1.

Figure 3 is a perspective view of one of the lamp shades used in the machine illustrated in Figure 1.

Figure 4 is a side elevation of the improved apparatus shown in Figure 1.

Figure 5 is a fragmentary plan view of the table which supports the printing frame of

the apparatus illustrated in Figure 1, this view being taken on line 5—5 of Figure 4.

The apparatus shown complete in Figures 1 and 4 includes a supporting frame 1, having on its rear side an upstanding post, 2, fashioned with a vertical slideway, 3, along which a forwardly projecting bracket, 4, may be actuated by means of a screw, 5, and a hand wheel nut, 6, adapted to thrust above and below against spaced ears 2—*a* and 2—*b* of the post through which the screw, 5, operatively extends. The bracket, 4, carries a lateral shelf, 7, on which is supported an electric motor, 8, which is subject to the control of a switch, 8—*a*, shown in Figure 1. The motor is operatively connected with so as to drive a worm wheel, 9, which is mounted at the top of the hollow shaft, 10, which passes downwardly through spaced bearings, 11, at the extremity of the bracket 4. The shaft 10, carries just below the lower one of the two bearings 11, a hub, 12, from which projects in one direction an arm, 12—*a*, along which a counter-balance weight, 13, may be adjusted. Extending in a diametrically opposite and downward direction from the hub 12, is an arcuate arm, 14. Fixedly attached directly underneath the hub 12, is an electric lamp, 15, provided with a shade, 16, which will permit emergence of the light rays only through a central circular aperture, 17, as clearly disclosed in Figure 3. The curved arm 14 is fashioned with a similar curved slot, 18, along which a plurality of slotted crosswise extending brackets, 19, (four being shown) may be adjusted in three distinct ways and fixed in any selected positions by means of wing nuts, 20. After loosening any nut 20, the slotted brackets 19 may be reciprocated either along the slot 18, crosswise thereof, or may be swung through an arc, for instance, to the dot and dash line position of the lower one. The four individual lamp brackets 19 will thus be capable of universal adjustment in one plane, that is, they can be raised or lowered either collectively or individually. They can be tilted to any effective angle, and they can be moved to or from the center of the arc described by the slot 18. Manifestly, also, the brackets 19 can also be located on the arc of any circle within the range of the apparatus. The lower end of each bracket 19 carries an electric lamp 21, enclosed in a quadrilateral shade, 22, with its downwardly presented side fashioned with a round opening, 23. A source of electric current (not shown) will be supposed to be connected with the five individual switches, 24, one for each of the five lamps. The conductors, 25, extend between each lamp and its corresponding switch, and the common return wire, 26, is connected with all the lamps and all the switches. The electrical connections just described are diagrammatically illustrated in Figure 1, and it has not been deemed necessary to illustrate completely the electrical connection with each lamp other than to disclose one feasible type of electrical connection capable of being maintained during the rotation of the lamp 15 and the revolution of the four lamps 21. Such a connection is shown to consist of six collector rings, 27, which are mounted on the shaft 10 between the bearings 11, which are adapted to have contact with brushes, 28, carried by a brush holder, 29.

The frame 1 suitably carries a bearing, 30, in which is rotatable a hollow spindle, 31, integral with a round printing frame table, 32, on which rests a printing frame, 33, of any approved or conventional design, and preferably including a vacuum pad, 34, such as is in common use in the art. A hose, 35, is shown to be connected with the hollow spindle, 31, by means of a stuffing box, 36, and also to be connected with a vacuum pump, 37. A valve, 38, is shown for the purpose of controlling communication through the hose 35, also an electric motor, 39, for driving the pump 37 and a switch, 39—*a*, for controlling the operation of the motor, 39. The function of the vacuum apparatus just designated is to maintain the uniform contactual relationship between the elements which are to be mounted in the printing frame.

As will be seen on inspection of Figure 5, the periphery of the table 32 is fashioned with a plurality of notches, 40, which are equispaced therearound and denote divisions of 15° each. A plunger, 41, is responsive to the action of a spring, 42, and operatively mounted on a small bracket, 43, which is appropriately located on top of an extension of the bearing 30, whereby the plunger 41 may be successively urged into any one of the notches 41 during manual rotation of the table 32, and thereby selectively serve as a detent to hold the table in any chosen position of 15° variation.

The bearing 30 is capable of oscillation by reason of having diametrically opposite extensions which are mounted by means of two trunnions, 44, which are turnably connected to the frame 1, as indicated by the dotted lines in Figure 4. Since the spindle 31 and print table 32 are carried by the bearing 30, they are likewise capable of a limited range of oscillation. A hand-wheel nut, 45, and lock nut, 46, are provided as shown in Figure 4, for the purpose of locking the table 32 in any effective tilted position desired, as, for instance, to the position shown in dot and dash lines in Figure 1. I have shown power mechanism for oscillating the print table 32, consisting of a connection with the bearing 30 at 47 of a link, 48, which articulates with a lever, 49, which is in turn pivotally connected with a grooved cam, 50, driven through reducing gearing, 51, by an electrical motor, which is subject to the control of a switch 52—*a*.

It should now be manifest that by use of different combinations of the several features of invention which I have herein disclosed, it is possible successfully to realize accurate reproduction of an infinite number of tonal variations existing in the subject of which it is decided to make a printed image. Some of the described elements are intended for alternative use and others for conjoint or cooperative use. Duplicate results may also be obtained in different ways, as for instance, by the use of the lensic screens shown in my identified patent without some particular adjustment provided in my printing apparatus or with some particular adjustment prior to exposure or some particular movement imparted during exposure. As an instance of how a like result may be produced in two different ways, it may be stated that the lateral displacement of any particular dot recordation, may be effected either by a series of six successive circular adjustments of the light or by a series of six successive circular adjustments of the printing frame; also that an annular recordation, may be obtained either by rotating a light which is not in the vertical center line of the printing frame or by rotating the printing frame while the rays of light are directed obliquely toward it.

I claim:

1. In combination with a photographic printing frame adapted to hold a sensitized element, a negative and a lensic screen in feasible relationship; of a lamp and doubly selectable means for varying in different ways the operative relationship of said frame with respect to said lamp and also of said lamp with respect to said frame.

2. In a photographic apparatus, the combination of a frame, a bearing trunnioned on said frame, a spindle rotatably mounted in said bearing, a printing frame table carried by said spindle, mechanism for fixing said bearing in any chosen position of tilted adjustment and power means for oscillating said bearing through a predetermined arc of movement when said mechanism is in its inutile position.

Signed by me, this 20th day of October, 1927.

VICTOR C. ERNST.