

MAP REPRODUCTION

GLASS NEGATIVE ENGRAVING

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(Extracts)

The manner and method of reproducing on the printed sheet the results of topographic and hydrographic surveys are varied, but always the effort is made to reproduce the material in what is termed conventional form.

Thus in the reproduction of topographic quadrangles of the Geological Survey, Tennessee Valley Administration, Coast and Geodetic Survey, Army Map Service and many commercial city surveys, adherence to convention is traditional. Culture, (the works of man) is reproduced in black, contours in brown, and drainage in blue, and effort is likewise made to insure a quality in the printed sheet equal to the high standards and practices long established by the Coast and Geodetic Survey and the Geological Survey.

To produce the accuracy and the artistic delineation of such standards it has been generally believed that it was possible to reproduce such work only by means of copperplate engraving. In the Coast and Geodetic Survey where the reproduction of the nautical chart has called for adherence to such accuracy and quality, there has long been practiced the method of "negative" or glass engraving, to reproduce new charts, or to correct areas on the negatives of those charts previously engraved on copper.

This method produces accuracy and quality the equal and in some respects greater than copper engraving. Its economy and the possibility of readily training draftsmen as negative engravers led to its adoption in the Coast and Geodetic Survey, where it has superseded copper engraving.

Its advantages, likewise, over the method of preparing drawings with pen and ink are many. A quality that cannot be equaled, and its economy are the principal advantages. Those who have endeavored to produce fine work with pen and ink understand the difficulties encountered in the effort to produce uniformity of lines. The proper pen point, the ruling pen, the single and double swivel; each require constant care in the attempt to secure a uniform flow of ink on the drawing. Also every effort must be made to insure that the work is always dense black in order to provide suitable copy for photolithography. The character of the paper on which the drawing is made seems always an obstacle in securing fine and uniform black work, especially if color separation is required on blueline prints on mounted paper.

In contrast to these difficulties is the ease with which this work can be accomplished in negative engraving. Steel points in special tools provide uniformity without effort for any character of work; the engraver's chief task is expended in following accurately the visible lines on the negative for the color that is required.

To illustrate the facility and uniformity with which the features of charts and maps can be engraved on glass, with tools designed for the purpose, see illustrations appended to the pamphlet (*not reproduced here*).

The first illustration shows the tools generally used and which were designed to obtain full advantage of the possibilities offered by the method.

Illustration 2 discloses the extent to which the rigid graver lends itself in engraving lines of various, microscopically determined, widths, obtained by the interchange of steel points. Note the range and the uniformity of lines engraved in strengths from .002" to .015".

Illustration 3 shows the character of engraving on glass with the swivel graver for producing double line roads and streets, or single lines where curves are gradual and the use of the swivel may be more advantageous than the rigid. Both the rigid and the swivel gravers can be used for straight lines with straight edge or triangle.

The maximum of efficiency has been accomplished by keeping the engraving points of tools perpendicular to the plane of the negative, for in this position with the engraving points properly sharpened, lines may be followed in any direction, straight, curved, and reverse curves, and a uniform strength of single or double lines maintained.

Referring again to drawing with pen and ink, the method of preparing finished drawings of topographic quadrangles, or similar charts and maps, is as follows; the compilation is photographed and the resulting negative is used to provide blueline prints on mounted paper or vinylite plastic, one for each color, and on these, drawings are prepared. Drawings may also be prepared without recourse to bluelines by tracing from the compilation on matte surface transparent vinylite. When the drawings have been completed they are photographed to provide negatives for lithographic reproduction.

Negatives made from drawings always require painting and retouching, often quite extensive. Pinholes and spots resulting from the wet plate method of photography must be eliminated by careful painting, and all weak work resulting from grey or thin drafting must be retouched (opened) to reproduce properly. Such painting and retouching, always necessary when negatives are made from drawings are entirely avoided in the method of negative engraving.

The following is a description of the application of "negative" engraving as practiced in the Coast and Geodetic Survey in the reproduction of charts and maps.

On the original, which might be a compilation by multiplex or stereophotogrammetric methods, planetable surveys, or other precise methods, the lettering, impressions from type in proper styles, is mounted in place to become the final lettering of the chart.

The compilation is then placed in the camera to obtain wet plate negatives, with emphasis upon obtaining the best definition possible of the lettering. A separate negative is made for each color to be engraved.

On the negative to be used for culture and lettering, the lettering is painted over with a water soluble opaque to protect it in the process of applying the engraving ground with which each negative is to be coated in a whirler.

This ground is an excellent engraving surface, is non-actinic, permits the engraver to follow readily, on the light table, every detail of the compilation, and does not print nor interfere in the processes that follow.

After the ground has been applied, the negative on which the lettering was covered with opaque, is washed with running water to dissolve the opaque and remove the ground covering the lettering, it is then ready for engraving.

The possibilities in delineation are limited only by the skill of the engraver or by the tools with which the engraving is accomplished. Fidelity to microscopically established standards is readily accomplished. Tools have been developed to utilize advantages peculiar to negative engraving, where the ground protected emulsion on glass provides a medium for engraving that is readily responsive to tools designed to produce desired results.

For the engraving of the culture (black), such tools as swivel, rigid graver and building graver (see illustrations) are those used in producing roads, trails, rail-roads, buildings, etc., and are provided with interchangeable engraving points for the varying widths of roads, thickness of lines, sizes of buildings, etc.

For contours, the rigid graver with the proper point is used for producing the heavy lines, and the pencil type fine graver (see illustrations) for the fine lines.

For drainage, the pencil type fine graver, if desired, may be used for headwaters, followed by the use of the rigid graver with varying points for increasing widths of streams, and for the uniform thickness of the shoreline of lakes and double line streams.

On charts or maps where the lines of latitude and longitude, or borders, must be subdivided into minutes or seconds, a mechanical subdivider provides a rapid and accurate means of engraving these on the negative, subdivisions of varying lengths with any desired spacing can be accomplished.

The important factor in engraving on the glass negative is keeping the engraving points of the rigid graver, the swivel graver, and the pencil type fine graver, perpendicular to the surface being engraved, for in this position continuous lines such as contours with any character of curve may be rapidly engraved without lifting the tool from the surface.

In addition to the method of applying the lettering, from type, to the compilation as described, alternate methods may be used in preparing the lettering. In one alternate method a combined blue-line of the culture, contours and drainage is made on paper mounted on metal and on this print the lettering is mounted, after which it is photographed to obtain a negative of the lettering only. The culture negative and the lettering negative are then used to make a composite process plate for the printing of the map.

In another method a black emulsion process print of the engraved culture negative is made on white vinylite on which blue prints of the contours and drainage have been made in register, and on this print which is ideal for photolithography, because of the density of the black and fidelity to the engraving, the lettering, from type, is mounted in place after which a negative is made that combines both culture and lettering.

From these negatives lithographic printing plates are made directly to aluminium or zinc for offset printing, which avoids the necessity of making such plates by transfer from copper or photolithographing prints made from copper or from drawings prepared as previously described.

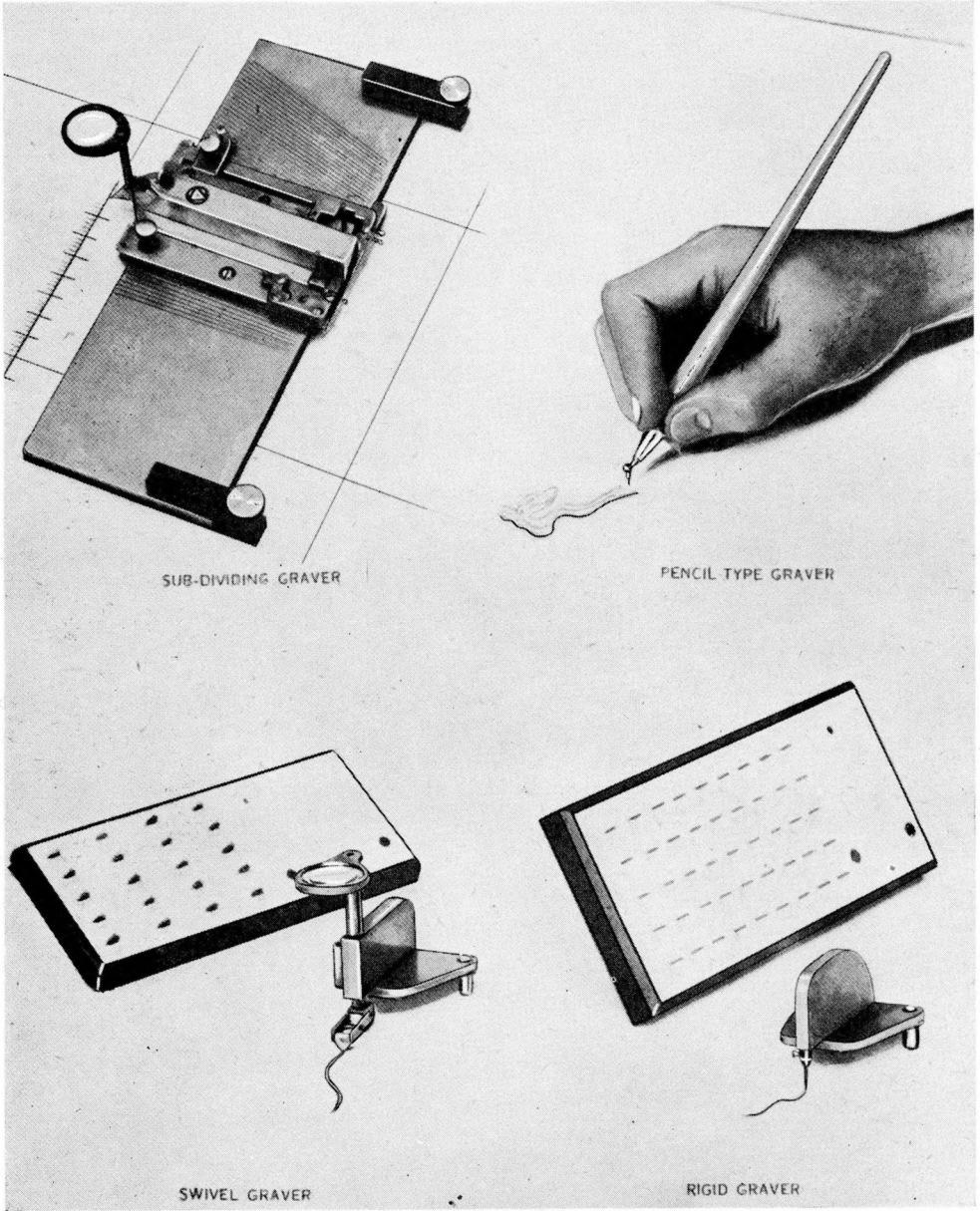
CORRECTIONS.

One of the most important factors in glass negative engraving is the facility with which wet plate negatives can be corrected for changes required when charts and maps are revised for future editions. Changes required, even the most extensive, can readily be made on the negatives to conform precisely with the quality and character of the original, whether engraved on glass, on copper, or prepared by drawing with pen and ink.

Original drawings on paper or plastic deteriorate with age and use and it is difficult and at times impossible to make extensive changes on them, and the effort to use them results in poor reproduction.

Correcting the original copper plate can be successfully accomplished but is tedious and slow and has long been abandoned in this office.

When extensive changes are made, on either drawings or copper, new negatives are required, painting and retouching is again necessary and always



SUB-DIVIDING GRAVER

PENCIL TYPE GRAVER

SWIVEL GRAVER

RIGID GRAVER

FIG. 1
Engraving Tools.

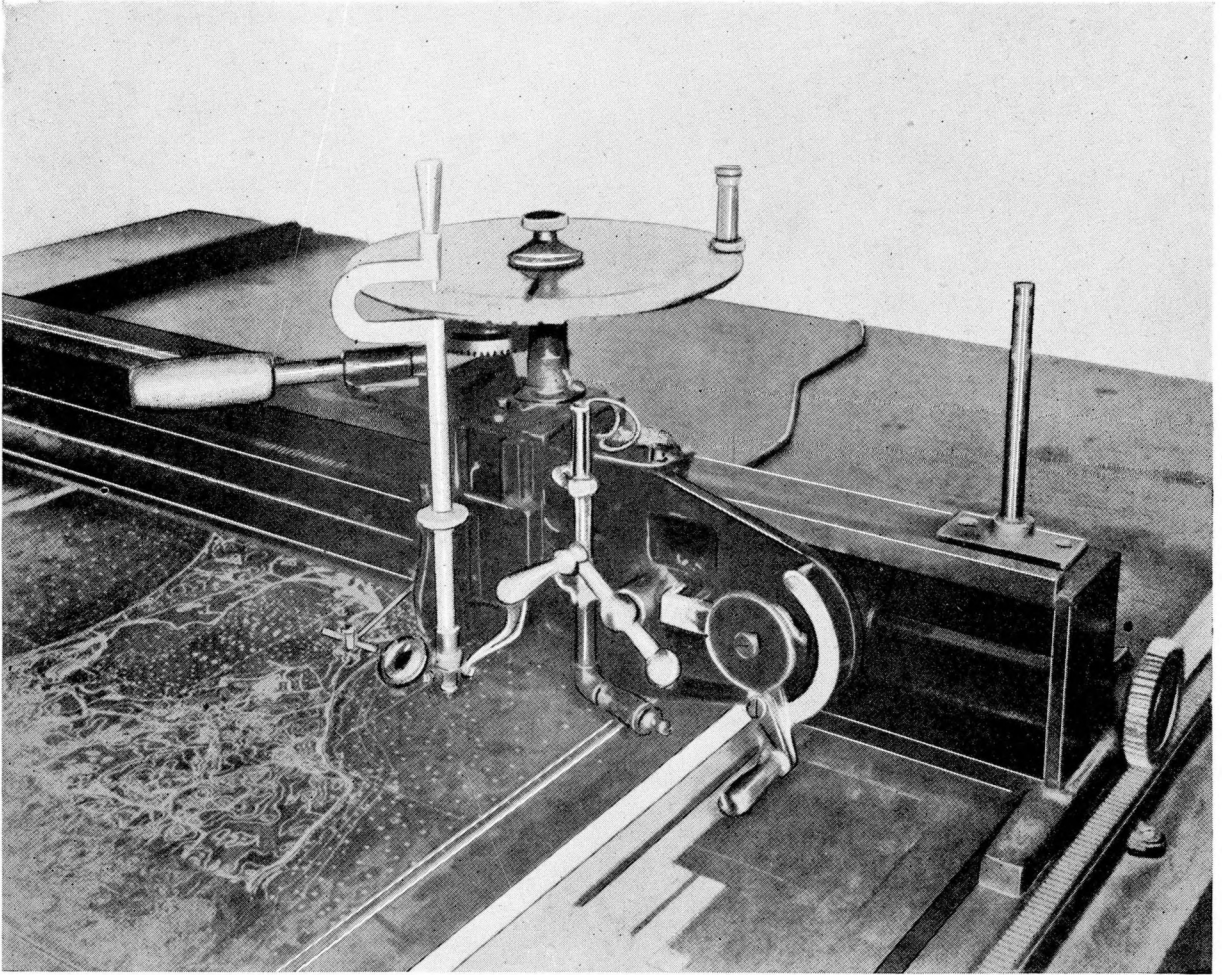


FIG. 2
Sounding Engraving Machine.

more extensive than previously, when the method of correcting the original drawing has been followed.

Revising charts or maps by engraving the changes on existing negatives is both practical and economical.

With tools designed to achieve speed, accuracy and quality, and photo aid to avoid hand tracings, changes can be made more rapidly than by any other method, a saving in photography and no retouching.

The emulsion surface of the negative is an excellent medium for correction work either minor or extensive.

In correction work, the part to be eliminated is painted out, and if the amount of change is minor it can be traced with a lithographic needle on celluloid or gelatin, and after red chalk has been applied to the tracing, it can be burnished down on the negative and the changes engraved.

If the changes are extensive and it is desirable to avoid hand tracing, the sheet showing the corrections is photographed, the resulting negative is processed to a metal printing plate from which a print in white ink is made on transparent vinylite, vermilion powder is applied to this print while the ink is moist, the ink absorbs the powder and affords the engraver a facsimile of the correction in red which he can burnish to the negative as a guide for the new work to be engraved.

Should extensive corrections require changes in lettering beyond that considered advisable to engrave by hand, such lettering is set up in type and the impression photographed to obtain wet plate stripper which is mounted in place on the negative by the engraver, or alternately, when the correction, except lettering, has been engraved, the black print method on white vinylite, as described above may be used.

With the nautical chart, though the procedure and tools used are similar, all topography and hydrography are engraved for reproduction in black, with colors used to emphasize various features, such as buff for all land areas, blue to emphasize water areas between the shoreline and designated depth curves, combination of blue and buff to emphasize marsh areas, magenta to emphasize aids to navigation, and red to show cable areas, anchorages, etc.

The details of the nautical chart are somewhat more complicated than most any other character of map production, and accuracy in reproduction of either the new chart or the extensive changes, which constitute the majority of the work, is most important, and here the negative engraving method and tools serve efficiently and economically.

The soundings, figures on the chart which show the depth at that particular location, and the lettering abbreviations showing the character of the bottom are mechanically engraved on the negative on the "sounding" engraving machine (illustrated).

The character of delineation on the topographic quadrangle and the nautical chart is shown on illustrations accompanying the pamphlet (*not reproduced here*).

