DEVELOPMENT OF NEW COMPUTERIZED ORIGINAL LAYOUT DRAWING MACHINE

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Abstract: The original drawing and layout steps in the printing process have been largely dependent on the skill of an individual. Now Toppan Printing Company has developed a Computerized Original Layout Automated Drawing Machine, DL-2500, to save time and labor in these steps. The machine is compact and easy to operate, using much newly developed original software. These include programs applicable to almost every printing field.

Introduction

In recent years the rationalization of printing has been occurring at a rapid pace. The speed and efficiency of presses have been significantly improved. Photo-typesetting, color scanners, roll film process cameras and automatic film processors have been introduced to rationalize the steps before platemaking. The main force behind these changes is electronics.

The color separation scanner is a good example of the utilization of electronics in printing. Also significant is the role played by electronics in tone control and masking. An advanced new technology has recently been developed in platemaking, represented by the Toppan® Image Conductor System (CP-525, ST-525) which electronically simulates color copy to develop an enlarged printed picture on the monitor. Computer typesetting is also coming into wider use throughout the printing industry.

Image processing through computer graphics has advanced rapidly. And Computer Aided Design (CAD) is playing a significant role in the design of electronic circuits. Design automation has reached a high level in the automotive industry, in shipbuilding and in architecture. However, the introduction of automatic drawing machines in

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the printing industry is a recent development and their adoption has been slow compared to other industrial sectors. As a result, some of the steps before platemaking continue to be performed manually.

Current Status of the Original Drawing and Layout Steps and Labor-saving Improvements in Them

The preparation of mechanicals relies on the skills of trained and experienced professionals who work manually from original copy. There has thus been a need for labor-saving mechanicals preparation by automatic processing to achieve an overall rationalization of the printing process.

Although the original drawing and layout steps rule the whole printing process, the size of the department in charge of this is traditionally small when compared to other departments in small/medium and large-scale printing firms. This is an important factor when considering the automation of mechanicals preparation. The equipment must be reasonably compact for this step to be conducted in a limited space.

The machine must be cost-effective and inexpensive to be utilized by small and medium sized companies. Installation in the present work space should be relatively simple and the equipment should be easily operated by a beginner at the same time that it motivates highly trained and experienced professionals and keeps them creative in layout and design (see Fig. 1).

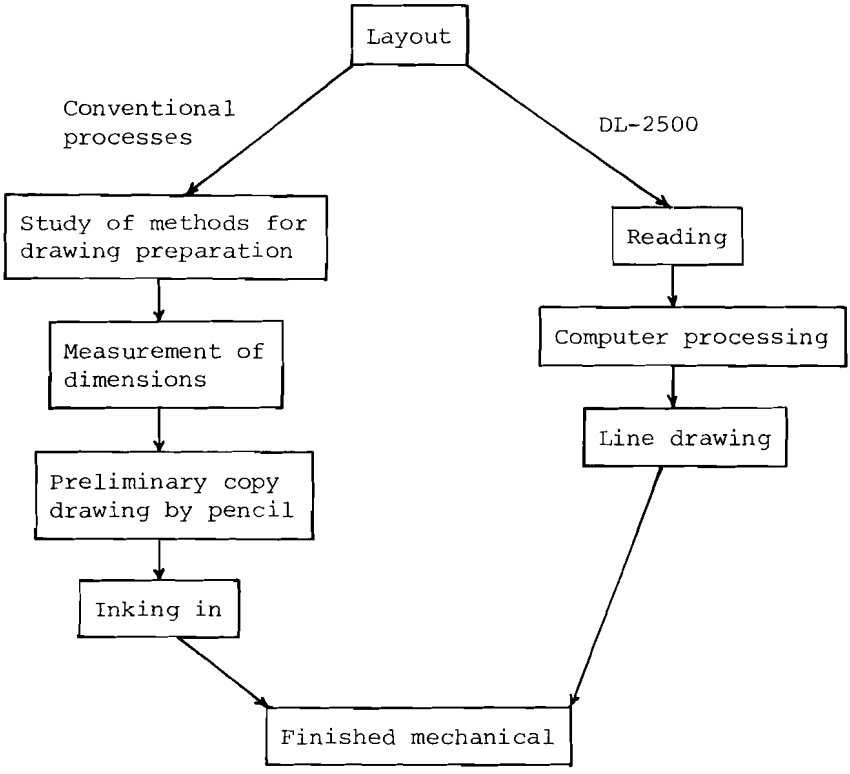


Fig. 1 Comparison of Toppan® DL-2500 and Conventional Processes

Factors to be Considered Before Adoption

1) Compactness

It must be recognized that the "assembly" concept (assembling independent, single-function machiens into one system) has limitations due to the space available and cost constraints. If a process which enables the machine to memorize originals (hereafter referred to as the reading operation) and a process which makes clean copies (the drawing operation) are carried out by separate machines, a larger work space may be required. Additional area is definitely needed if different machines check on the reading operation and on calculation/computation. Further, independent single-function machines may not be easily operated by one operator.

2) Use in Offices

In addition to compactness, the available power supply is another important consideration for use of this equipment under usual office conditions. It should function on ordinary power supplies. It is also desirable that the machine be no higher than a standard office desk. To prevent fatigue during long operating hours, the operator should be seated. And for maximum efficiency the machine should be designed to the latest human engineering principles.

In other words, the equipment must function as an office machine. If it can be operated with both hands, with clearly defined and suitably separated left and right hand functions, the machine is particularly suitable for office use by younger and less experienced operators.

3) Quick Checking

The functions of the machine should start with the reading of originals. If all the functions, such as reading, control and drawing, are on-line, it is possible to have a feedback mechanism to inform the operator of errors in operating procedures or reading during the reading operation.

The most important consideration for improved operating efficiency lies in the reading step. Because of the time required for reading and drawing, it is important to have a system in which the operator need have no doubts about reading accuracy. It is late to check reading accuracy after completion of the reading operation. Most drawing machines on the market have separate reading and checking operations and checking must be initiated after completion of the reading procedure. It is clearly more efficient to have a mechanism which feeds back information to the operator during the reading operation so that errors can be corrected at that time.

4) Ability to Respond

To prevent errors in the reading operation, it is desirable to have a dialogue capability as well as a quick checking mechanism. It is also better if the machine does not require uniform operating procedures but that these be adjustable, depending on the skill level of each operator. It is especially helpful for beginners if the machine has a mechanism to follow up and correct an inaccurate

operational sequence. This helps solve the problem of a shortage of skilled operators and longer training periods for beginners. This should be kept in mind when evaluating the performance of a system.

5) Ease of Data Handling

It is essential not to ignore the data handling step since this is always associated with the reading of originals. The handling of data therefore should be a simple procedure.

Floppy disks, paper tapes and magnetic cassette tapes are all presently used as data storage devices. However, disks are considered the most appropriate because of their speed, reliability, longer life and memory capacity. This is proved by their wide use as memory devices in business computers.

6) Free Curve Drawing Capability

A combination of straight lines, rectangles and circles cannot handle all the figures that may be present on originals. The machine must be able to draw free curves to handle all types of illustrations and expand its usefulness.

Up to this point the various ideal requirements for the mechanization of the original drawing and layout steps and the preparation of mechanicals have been considered. In the following sections the specific characteristics and functions of the Toppan® DL-2500, a computerized original layout drawing machine developed by Toppan Printing, will be described.

Hardware Configurations

The reading and drawing units are combined in Toppan's DL-2500 (see Fig. 2). Thus one operator can handle both reading and drawing operations while seated. Fig. 3 shows the hardware configuration of the system.

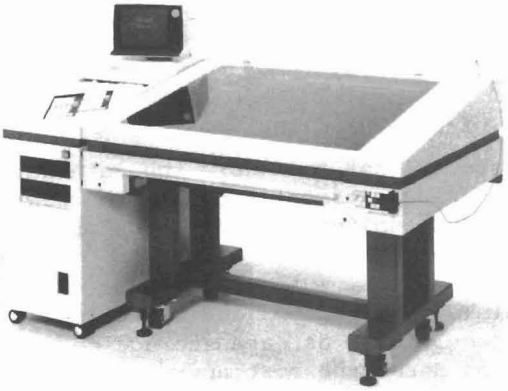


Fig. 2 Toppan® DL-2500

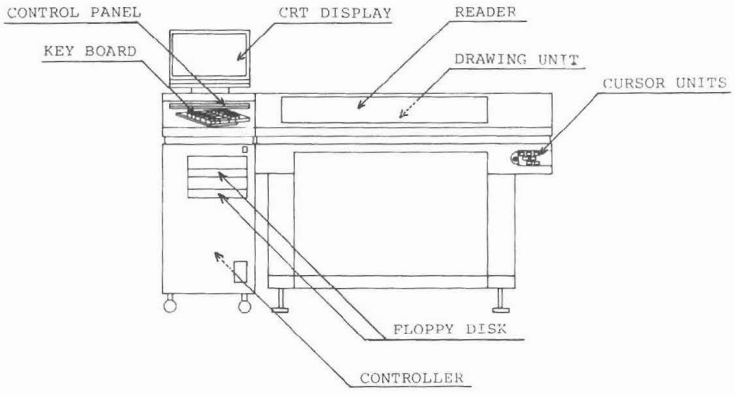


Fig. 3 Hardware Configuration

1) Reading

* Function keys

By touching these keys the operator signals the procedure to be followed to the machine. There are three types of function keys:

° Keys for operational functions such as Read - Start

° Keys for drawing specifications such as straight line, circle, etc.

° Ten keys for numerical input for sizing, etc.

These function keys are on the left side of the machine and are generally operated by the left hand.

* Electromagnetic cursor

The cursor indicates the key position of the figure on originals. The red plus mark on the cursor unit is placed on the necessary part of the figure on an original and the operator punches the required keys for the figure to be read by the machine. The cursor is on the right side of the machine for right-hand operation.

* Display unit

The CRT display unit shows the position of the arm when reading or drawing to guide the operator. It can also display operation procedures to teach a beginner how to use the machine.

The machine is designed so that the right and left hand operations are clearly separated and yet to allow the operator to confirm an operation visually. When considering installation of such a machine it is important to pay attention to drawing quality. However, in actual use the reading function will be found to be the most important. Drawing quality has no relation to the operator's skill since the machine draws automatically. Some other machines require a certain operating skill which sometimes causes problems.

As soon as the data obtained by the reading operation are recorded on the floppy disk, the machine is ready for drawing. Special ink pens are used to draw lines on the sheet. Fine, medium and heavy lines can be drawn at the same time since three pens can be mounted for simultaneous

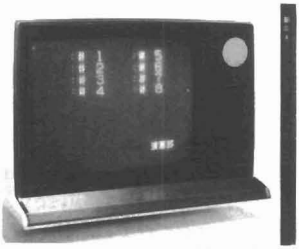
use. In addition, blue ink for paste-up guidelines can be used.

Reasonable care must be taken to prevent ink blurring and clogging during use to ensure the quality of the mechanicals (see Fig. 4 and Fig. 5)

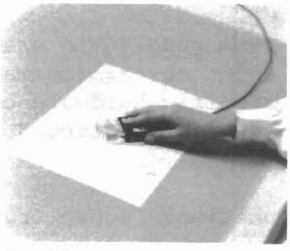
Drawing Unit	
Effective range	(X)654 mm X (Y)480 mm
Minimum setting	0.025 mm
Drawing speed	15cm/sec max
Fixing method	static absorption
Drawing heads	4
Reading Unit	
Effective readable range	(X)654 mm X (Y)480 mm
Reading system	Cursor and ten key input
Display	9-inch CRT
Control Unit	
I/O specification	keyboard and cursor
storage	floppy disks
Power Supply	
Power requirement	AC 100 V 50/60 Hz 500VA max
Weight	195 kg
Size	1470 mm X 840 mm X 1060 mm

Fig. 4 Hardware Specifications for Toppan® DL-2500

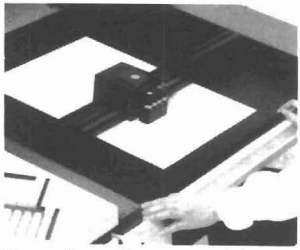
1) Reading Preparation



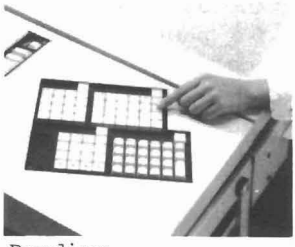
4) Reading (CRT display)



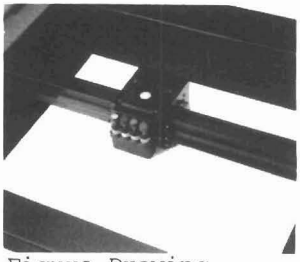
2) Reading
(using a cursor)



5) Drawing Preparation



3) Reading
(keyboard operation)



6) Figure Drawing

Fig. 5 Operation Procedures for Toppan® DL-2500

Description of Software

1) Standard Software (Toppan® ADOS-II)

Great attention has been paid to clearly defining the rules for keypunching for the reading operation with the Toppan® DL-2500. The rules thus can be easily memorized by the operator to achieve greater efficiency. Since the reading operation is the very point of the man-machine interface, the machine must be connected to a computer on-line to permit interactive communication. If the reading unit were to be an independent single-function machine separated from the drawing unit, dialogue would be impossible, making the operator uneasy.

The series of operating steps from reading to drawing has been broken down and grouped under certain commands. Each task has been assigned to a specific hardware component and the software system is designed to respond to these assignments.

The machine has two types of function, Figure Drawing and Other.

* Figure Drawing Function

The Toppan® DL-2500 can draw straight lines, rectangles, circles, ellipses, arcs and other geometric shapes. It can also draw such figures as rectangles with rounded corners, grids and parallel lines for photo layouts. It can draw both standard and non-standard size positioning marks and one of its special characteristics is the ability to draw free curves.

* Other Functions

Additional functions include ink pen selection, deletion of typing errors, figure cancellation and pen testing (see Fig. 6, Fig 7, and Fig. 8).

Figures:

positioning marks, straight lines, inclined lines, circles, circular arcs, rectangles with 2R, rectangles with -2R, rectangles with 4R, rectangles with -4R, sectors, sectors with 2R, rectangles, grids, parallel lines, ellipses, multiple rectangles, multiple circles, broken lines, blique lines, inclined rectangles, declined parallel lines, parallel grams, rhombuses, arcs, straight lines with R points connection, right angle points connection, rectangle for guiding paste-ups

Function:

pen selection, pen testing, pen adjustment, transfer, grid over-flow (warning), cancellation, response, plurel, partial not round, partical deletion, transfer & copy, inclined figures, oblique grid, overlap, multiple figure, reduction, expansion, ten-key input, area check

Fig. 6 Toppan® ADOS-II (Software) Specifications

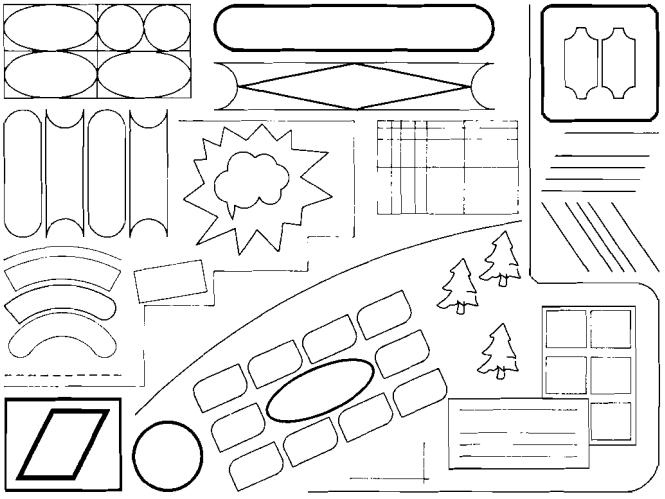


Fig. 7 Standard Pattern of ADOS-II

Fig. 8 Sample Drawing

2) Application Software Packages

* Toppan® ADOS-FORM

This package is for business forms generated by computer. It allows processing of information based on inches as well as centimeters. It can also specify dotted lines for figures such as rectangles, circles, ellipses, etc. (Fig. 9)

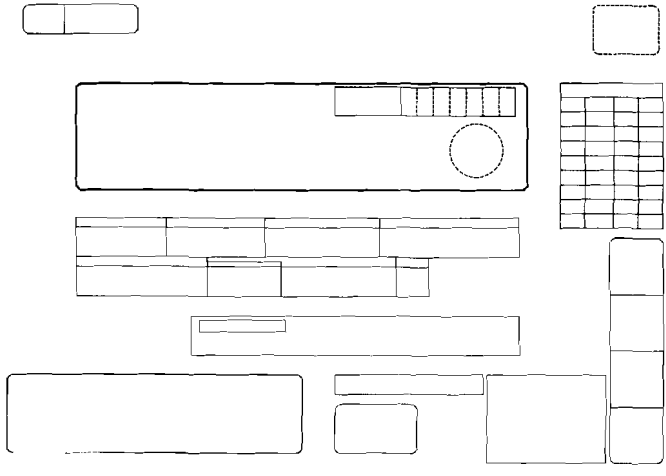


Fig. 9 ADOS-FORM

* Toppan® ADOS-CUTTING

This is interface software for cutting peeling films, enabling the Toppan® DL-2500 to connect mask cutting machines such as the Toppan AC-30, off-line. (Fig. 10)

Fig. 10 ADOS-CUTTING

* Toppan® ADOS-LETTERING

This is a heading drawing package to freely change the shape of large letters which cannot be handled by photo-typesetting and lay them out at any desired position on the sheet. (Fig. 11)

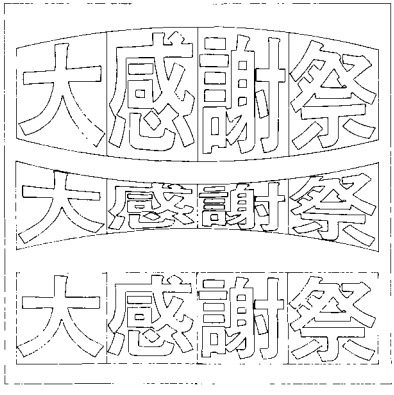


Fig. 11 ADOS-LETTERING

Since printing is performed on a wide variety of materials, including cloth, metal, plastic and electronic circuits, there are many different kinds of mechanicals. For the overall rationalization of the printing process, both automation and mechanization are required, especially in the preparation of mechanicals. Tasks for the future include connecting cameras, scanners and photo-typesetters to a computerized original drawing machine.

* Acknowledgment

The Toppan® DL-2500 was developed jointly with Watanabe Instruments Corp. at the request of the All Japan Printing Industry Association.

* Reference

U.S. Patent 4313073, Jan. 26, 1982, "Interactive Graphic Apparatus," applies to the Toppan® DL-2500.

APPENDIX

Machine	Hardware Specifications			
	Size	Computer	Data storage	Mask cut attached
Toppan® DL-2500	A2+α	Micro	Floppy	No
A	B3	Micro	Paper tape	No
B	B2	Micro	Floppy	No
C	A1+α	Micro	—	No
D	A1+α	Mini	Paper tape	No
E	A1	Mini	Floppy	Yes
F	A0	Mini	Floppy	Yes
G	A1	Mini	Floppy	Yes
H	A0	Mini	Floppy	Yes

Fig. 1 Comparison of Several Drawing Machines in Japan

Months after installation	Number of mechanicals	Operating hours (H)	Converted hours to manual operation	Efficiency (%)
1	300	120	270	225
3	1,000	150	470	313
6	1,200	150	490	327
Max.	1,600	160	720	450

(per month)

Fig. 2 Examples of Actual Operation by Toppan® DL-2500