6-1-1976

A quantitative method of pre-setting the ink distribution keys of an offset duplicator using a photoelectric estimating unit

Martin Marino

A QUANTITATIVE METHOD OF PRE-SETTING THE INK DISTRIBUTION KEYS ON AN OFFSET DUPLICATOR USING A PHOTOELECTRIC ESTIMATING UNIT

by

Martin J. Marino

A thesis submitted in partial fulfillment
of the requirements for the degree of Master of Science
in the School of Printing
in the College of Graphic Arts and Photography
of the Rochester Institute of Technology

June, 1976

Thesis adviser: Dr. J. L. Silver

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CERTIFICATE OF APPROVAL

MASTER'S THESIS

This is to certify that the Master's Thesis of

Martin J. Marino

with a major in Printing Technology
has been approved by the Thesis Committee as
satisfactory for the thesis requirement for the
Master of Science degree at the convocation of
June, 1976

Thesis Committee: ______________________
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ACKNOWLEDGMENTS

I wish to express my sincere thanks to Dr. Julius Silver for his guidance in the completion of this study. I would also like to thank the other members of the thesis committee for their valuable time.

I am especially grateful to Professor John Carson of the Photographic Science Department who was instrumental in designing the necessary optics for the estimating unit. Without his assistance this study would not have been possible.

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A QUANTITATIVE METHOD OF PRE-SETTING THE INK DISTRIBUTION KEYS ON AN OFFSET DUPLICATOR USING A PHOTOELECTRIC ESTIMATING UNIT

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An Abstract

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ABSTRACT

The purpose of this study was to study the feasibility of quantitatively pre-setting the ink key distribution on an off-set press. Presently the pre-settings of the ink keys has been left to the pressmens' ability and experience. This, in many cases, involves much "trial and error" work along with lengthy makeready times. This study attempted to reduce makeready time by quantitatively pre-setting ink keys from data obtained from an estimating unit and use of a set of calibration curves.

A photoelectric estimating unit was designed and constructed to read integrated densities of copy to be printed. There was one reading for each area of copy corresponding to an ink key on the press. The estimating unit consisted of a series of lenses, a photoelectric tube and a meter movement. The estimating unit yielded readings of the image area for which an ink key is responsible for the supply of ink.

The press was a standard off-set type with small paper dials mounted on the face of each ink key. A series of calibration tints were printed. From these tints key settings and their estimated density values curves were generated for use in the pre-setting of the ink keys for any type of copy.

Through one test it was found that there are many ways to have the ink keys set and still have the job within specifications. The reasons for this are explained within.

Sample copy was read using the estimating unit. Through a series of steps predicted ink key settings were found. This copy was then printed using the ink key pre-settings. All press runs were evaluated to determine whether or not the pre-settings were producing printed copy within specifications.

One hundred and ten possible ink key pre-settings were attempted. The results of the study show good correlation between pre-setting ink keys and actual settings done entirely empirically. With a quantitative method pre-setting the ink distribution keys, the makeready time required will be shorter.

Abstract approved:

, thesis adviser

, title and department

, date

CHAPTER I

INTRODUCTION

It is the writer's experience that after a plate is handed to a pressman and positioned on the press, the pressman must make an "educated guess" as to how to set the ink distribution keys. The pressman, depending on his ability and experience, reads the plate and judges where the various spots of copy are located in relationship to the ink distribution key setting. The operator, through his experience on past jobs, turns the fountain keys until he "feels" that a sufficient amount of ink will be discharged to cover the entire image area for which that particular key is responsible.

The press itself, as well as the pressman, are a very important consideration when discussing the amount of setting-up or makeready time. If a pressman has had much experience on one particular press, the makeready time should be relatively small, as opposed to a pressman whose experience has been limited on that machine. Moreover, if one pressman has had much experience in setting-up for difficult image arrangements (those arrangements that invite the problems of ghosting, starvation, and across the sheet variation) he too should have less makeready time than a pressman who has not encountered much of this troublesome copy. This concept of faster makeready with more experience is an example of using the learning curve.

The problem of pre-setting the ink distribution keys is inflated when difficult copy is to be printed by an operator who has had limited experience in setting-up for this type of copy. Because of this predicament, a way to accurately measure the amount of ink needed by each ink key to produce a quality print should be determined, and a scheme for pre-setting these ink keys developed.

Statement of Problem

High press makeready time in today's high speed production schedule is a cause for less efficient productivity. Makeready time can often approach the total time it takes to actually run the entire job. Makeready as we see it in today's industry must be done, and done quickly to allow greater total production.

Joseph A. McSweeny and John R. Metcalfe in a 1970 Technical Association of Graphic Arts report on "Lithographic Press Controls" stated:

> The only time research took place was on the jobs that did not perform as they should or when problems existed to cause down-time on the press. He suggested (talking of Bob Walters of Fawett-Haynes Printing Corporation) research take place to insure all jobs become more predictable and hopefully more jobs could be run well without presenting problems.[1]

To do this a means of reducing the time it takes to either set up the feeder and delivery, placing the plate on the press, or adjustment of the ink system has to be developed. The scope of this study is to attempt to arrive at a technique to reduce makeready time pertaining to the ink distribution system, more precisely, the pre-setting of the ink keys.

"Studies of makeready on a multicolor sheetfeds often showed that a large portion of the time was taken up in the setting ink fountain keys, and getting color up to O.K."[2] When a pressman starts a job he tries to get the correct amount of ink on the plate as quickly as possible. He does this by adjusting the ink distribution keys prior to starting the press initially. The pre-setting of the keys is based on his estimate of ink demand of the plate. For less experienced pressmen, a technique suggested by L.T.F. (G.A.T.F.) is to make two complete turns of the key for a solid, one-and-one-half turns for a three-quarter solid plate and so on. "Using this as a starting point for fountain setting, or as a basis for developing your own personal system, any press may be mastered in comparatively short time."[3]

Until 1974,[4] there was no previous quantitative undertakings to pre-set the ink distribution keys for first run jobs. Some press manufacturers have developed systems (using dials on the ink fountain keys) to record setting of these keys after the pressman would simply set the dials to match the recorded results and the job could be set-up quickly, thus saving the makeready time.

May and Silver, in a study of the pre-setting ink keys, encountered some difficulties. In order to properly pre-set ink keys an accurate assessment of the ink coverage has to be determined. A grid system for visually scanning the plate was proposed. The grid consisted of horizontal and vertical lines drawn on a clear plastic sheet. The vertical lines were drawn to represent the area in which a particular ink key would be responsible. The horizontal lines were arbitrarily but evenly spaced to form rectangles. The grid was placed over the plate and each rectangle was "read." "For a given plate area, the proportion of image area to non-image area was estimated in terms of percentage of image area."[5]

Arbitrary numbers were assigned to each rectangle. The total of the rectangles were used to obtain a number for that ink key column, which later could be correlated to an ink dial setting.

In theory, this system should suffice, but the scanning was only an estimate* of the total image to non-image relationship. There was no accurate quantitative method used

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*May and Silver estimate used arbitrary figures of:
25% image area for Text type
62.5% image area for Bold Face type
100% image area for solids
5% to 95% image area for Halftones

for measuring the image area on the plate. Having been done with the naked eye, it is necessary to take into account some important factors; the estimate of the relationship of image to non-image areas will differ from person to person; different typestyles (i.e. bold, condensed) and different types of halftone will occupy different image areas. Because of these reasons, pre-setting of the ink keys, yet a closer attempt, was not developed to its full potential.

Purpose of Study

The main purpose of the study is to devise a method of pre-setting the ink distribution keys on a small offset duplicator. It is believed that a quantitative method of pre-setting the keys can be devised from readings taken directly from original copy. Until now the pressman had to rely on his past experiences in pre-setting the keys. He did this by visually scanning the plate to estimate where the image areas were located in reference to the location of the ink keys on the fountain. After "reading" the plate, the pressman has to make adjustments to the keys to correspond with his estimate of image areas, hopefully to the point where no further adjustments are necessary. Many times further adjustments have to be made to produce a quality print "...due to the lack of ability to estimate the work on the plate and its relation to ink demand...."[6]

If the pre-setting of the distribution keys can be determined correctly, this would be an aid in cutting down the makeready time it takes a pressman to set up for a job. "There will also be increased production output of manpower and equipment as well as less stock waste and use of less ink."[7]

If the ink distribution keys can be pre-set accurately for each job, less experienced press operators could be used effectively. There would be no need for an operator to have this special "feel" for pre-determining the ink key settings, which in most cases requires trial and error experience, and also has no quantitative base behind it.

A unit must be fabricated to make a reading of the existing copy. This reading device would incorporate a densitometer, and the readings taken could then be transposed to percent dot area. The first basic idea of this reading unit was proposed by F. Nyiri in 1959, "...Hungarian Printing Experimental Plant and Laboratory has constructed a photoelectric printing area measuring instrument."[8]

The unit originally designed to estimate the ink requirements in a printing operation used a simple lens to collect density readings from light passing through a negative mounted on a light box. "The greater amount of opaque areas on the negative will cause a high reading on the densitometer scale.[9] In this particular unit, after transposing to the percent dot area, the higher the reading the less ink would be needed for each job.

Many times negatives are not available if certain means of producing plates are used, as for example Kodak P.M.T., direct image plates, as well as electrostatically prepared. For this reason, it is believed that a reading unit which could read densities from hard copy would be more efficient and useful.

When the reading is completed, a correlation could be set up between the dials on the ink press keys, to show key movement, and these density readings of the copy through the densitometer. If the correlation is positive, this could be used for pre-setting the ink keys.

To summarize: The purposes of this study are as follows:

1. To construct a unit to accurately measure the density of an area of hard copy.
2. To correlate density readings of the copy to dial settings on the ink distribution keys.
3. To pre-set ink keys for future job runs to enable faster job makeready and to enable less experienced press operators to print jobs quickly and with quality.

Hypothesis

1. The estimating unit will accurately estimate the amount of ink need from each ink key to produce a quality print

(print quality parameters). Solid ink density between .90 and 1.20 with a variance of no more than .20 on any one piece of copy will be obtained.

2. The pre-setting of the ink distribution keys will cause a reduction in the makeready time.
3. The results of pre-setting ink keys are repeatable.

FOOTNOTES FOR CHAPTER I

[1]Joseph A. McSweeny and John R. Metcalfe, "Lithographic Press Controls," T.A.G.A. Proceedings (1970), p. 214.

[2]Roger Ynostrozo, "Remote Control of Ink Fountains on Sheetfed Offset," Graphic Arts Monthly (May 1973), p. 64.

[3]Inking System for the Lithographic·Offset Press: Shop Manual #5, L.T.F., Inc. (1945), p. 19.

[4]Bruce F. May and Julius Silver, "The Pre-setting of the Ink Distribution Keys on a Small Sheetfed Offset Press," (Masters Thesis, Rochester Institute of Technology, 1974).

[5]Ibid., p. 18.

[6]Inking System for Lithographic Offset Press, p. 18.

[7]May and Silver, p. 5.

[8]F. Nyiri, "A Photoelectrical Estimation of the Ink Requirement in a Printing Operation," Proceedings of the National Printing Ink Research Institute (1959), p. 312.

[9]Joseph E. Brown, "Estimating Ink Consumption on the Four-color Web Offset Press," (Masters Research Problem, Kansas State College of Pittsburg, 1961), p. 15.

CHAPTER II

METHODOLOGY

In this study of the ink distribution keys, there are certain variables that will be controlled. These will not act as factors affecting the results of the tests. These controlled variables are as follows:

<u>Press</u>

The press used for this study was an A.T.F. Chief 15 with chain delivery which operates at speeds from 4500 to 9000 iph. The inking system on the model 15 consists of ten rollers, and the dampening system of four rollers. All roller and pressure settings were adjusted to the manufacturer's specifications prior to use.

<u>Plates</u>

The plates used in the study were Enco "N-2" type manufactured by the Azoplate Corporation. The plates were exposed on a NuArc plateburner using a xenon light source, to the manufacturer's specification using a step wedge. The "N-2" is a negative working additive plate which requires only one operation to develop and lacquer. "N-2" plates were used for printing both calibration prints and sample copy.

Paper

The paper used in this study was Mead Company's Moistrite Offset. The substance weight was 50 pounds. The paper was uncoated.

Ink

The ink used was Inmont's P.M.S. Neutral Black. All ink was taken from the same batch to insure pigment and specific gravity consistency. The viscosity was assumed constant for each press run because the ink container was stored in the same place each time and the atmosphere was considered stable. Small amounts of ink were added to the ink fountain during the press runs instead of waiting until the fountain became low. "This is an attempt to keep the ink level constant, and to prevent large changes in temperature or body associated with addition of fresh inks."[1] Also, the ink was agitated to further insure that ink viscosity remained constant. Harry Hull, in a 1968 T.A.G.A. report explains, "The amount of ink delivered changes with the amount of ink in the fountain, the viscosity or body of the ink in the fountain, and the temperature of ink in the fountain."[2]

Fountain Solutions

The fountain solution used was Anchor Concentrate III 14° Baume gum solution made by the Anchor Chemical Company, Inc. The concentrate was mixed to manufacturer's specification to a pH of 5.0. The fountain settings were kept as constant as possible while not encouraging plate scumming (from too little water) or damp stock, delivery trouble or density washout (from too much water).

Quality Control Device

A densitometer was used to check the solid ink densities of the press sheets to insure that prescribed quality standards were upheld when both the calibration samples and sample copy were being printed. A reflection densitometer, model S.O.S. 40 was used which was manufactured by the Cosar Corporation.

Ink Fountain

May recommends that "a study involving pre-setting of ink keys with finer threads could give better results..."[3] Taking this into account a new ink fountain was made with finer threads (24 threads per inch was used in May's work). The new fountain was made with 32 threads per inch to yield smaller incremental movements of the fountain blade to fountain roller with each revolution of the ink key. "...a thickness" (ink film) "is dependent upon the amount of space between the fountain roller and the blade of the fountain."[4]

A way to determine the amount of movement of an ink key had to be devised for obtaining a quantitative setting. This was done by relating a series of numbers to these movements through a dial system. "The primary advantage of replacing subjective decisions with digits is said to be repeatability."[5]

The dial was constructed in such a manner to allow for fine adjustments, yet simple to use and read. For this reason a circle was used and broken up into twelve main divisions, and twenty-four smaller intermediate divisions. This dial, as stated in the requirements, allows for simple operation and also for fine adjustments. The dial was numbered from zero to thirty-six. (Figure 1)

The dial was drawn using mechanical drawing instruments. To ensure that all dials were identical, the master dial was photographed and contact prints were made.

To keep the construction of such a dial simple, a manual count was taken for each complete revolution of each ink key and recorded wherever required.

With the combination of a new ink fountain with finer threads (32 threads per inch) and a dial system with more increments in its circumference it was believed that a very precise quantitative analysis of ink key settings could be made.

Many unsuccessful attempts were made to print calibration tints. These prints were either starved of ink (low solid ink density) or scumming and dot gain occurred. The plates, dampening and inking rollers were checked for problems, but none could be found. It was then believed that the problem must lie in the ink fountain. After careful examination of the custom-made fountain it was noted that the ink keys were not contacting the fountain blade at its end, but rather

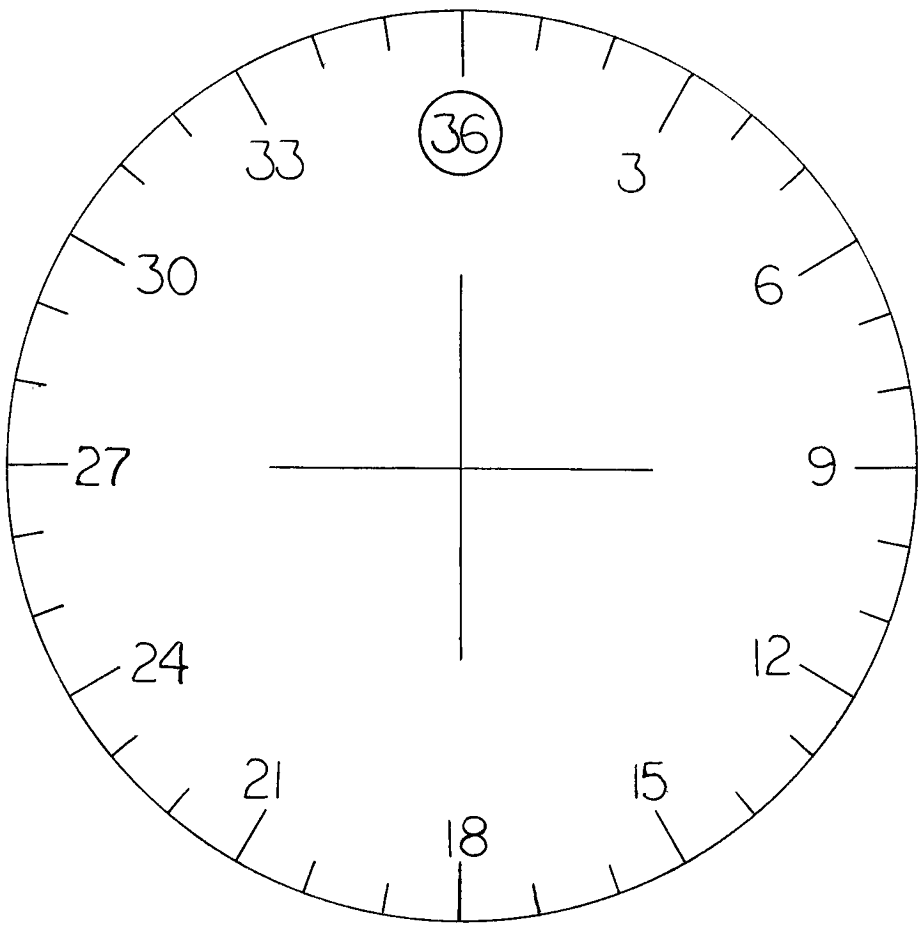

Figure 1. Ink key dial

towards the center. This was a very noticeable difference between the standard and custom-made fountains. It was noticed that the custom fountain when closing, closed on the high point of the fountain roller (point A, Figure 2) and bent the blade to where almost no ink was coming through to the fountain roller.

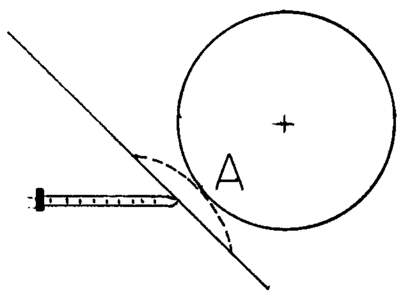

Figure 2. Custom ink fountain

In the opposite case, when the ink key was opened a small amount, it allowed too much ink to pass on the fountain roller. This seemingly binary situation happened within a quarter turn of the ink keys. Because of this situation it did not give the control needed for a study of this type.

The standard ink fountain was tried. The ink key screws being placed at the end of the end of the blade seemed to make the difference in control. When adjustments were made with this fountain the blade bent mostly at the end causing a large movement at point B, but a smaller more controllable movement at the high point of the roller (point C, Figure 3). It took approximately one full revolution to completely open

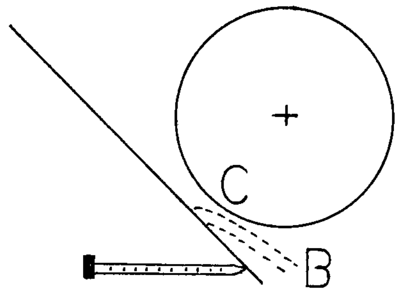

Figure 3. Standard ink fountain

or close this fountain. This is quite a difference when considering that the thread size is courser and the key movement much further with one revolution of the key on the standard ink fountain, (24 threads per inch) than with the custom fountain (32 threads per inch).

With the standard fountain, one revolution of an ink key moved the blade .04166 inches and for each increment (of which there is thirty-six) the movement was .00116 inches for each revolution and a movement of .00086 inches for each increment. One can easily see that if the custom fountain discharged ink in the same manner as the standard fountain it would have been able to give finer control.

Estimating Unit

Because of the author's belief that a true quantitative method of estimating image area is essential to the success of this study, an estimating unit had to be designed with the following requirements: a true reading of all types of image areas, (it should be noted here that copy with a certain density did not have to read that density on the estimating unit, but rather a relative value of that density i.e., a fifty percent image area would have a higher reading than a forty percent area, than a thirty percent area and so on...) the readings must be repeatable, the unit must be able to read copy with consistency from anywhere in the view of the estimating unit, and as stated earlier the unit should be able to obtain readings of image areas directly from original hard copy.

On the model Chief 15 there are thirteen ink keys on the fountain and thus thirteen keys to set when printing any given job. In order to set each ink key using a quantitative method the copy that will be printed by that ink key will have to be read by the estimating unit and a scale reading given. In order for this area alone to be read a copyboard and mask was constructed. The copyboard was divided up into thirteen sections, each .75 inches wide by 13.25 inches long. When added up this gave a maximum size of area to be read of 9.75 inches wide by 13.25 inches long which corresponds to the maximum printing area of the Chief 15 (see Figure 4).

A copyboard mask consisting of a sliding window .75 inches wide by 13.25 inches long was then made. This mask was used for reading any one slit that corresponded to a particular ink key as marked on the copyboard. Therefore, at any one time the area corresponding to twelve ink keys was covered (see Figure 5).

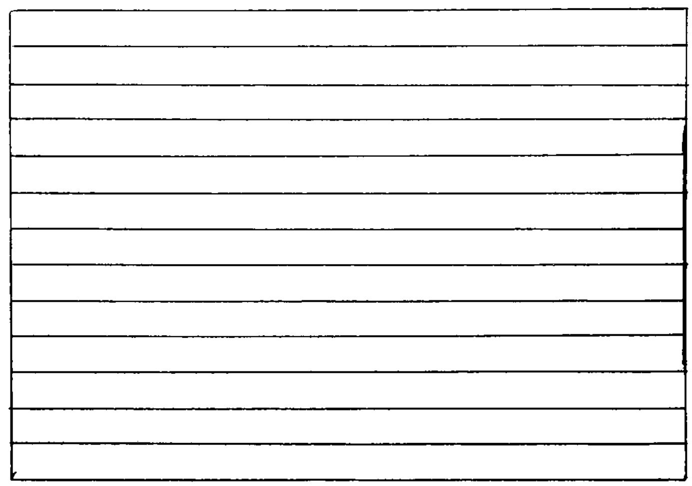

Figure 4. Basic thirteen sections of copyboard

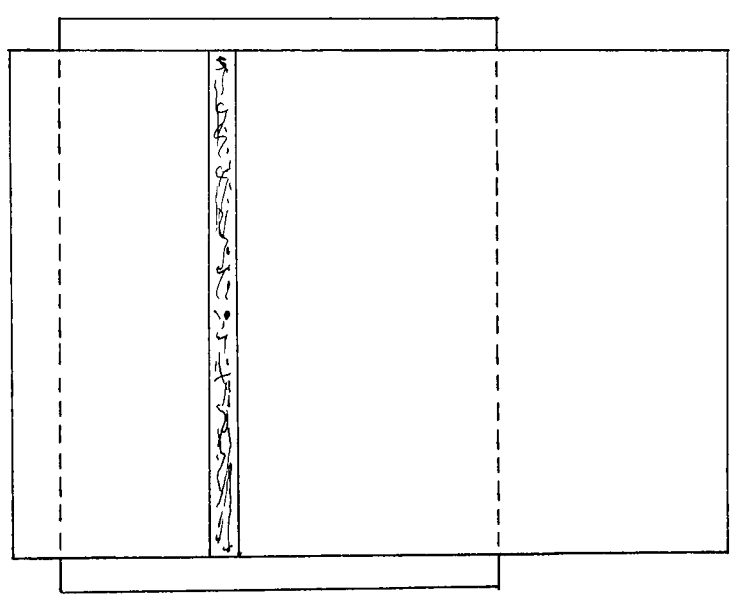

Figure 5. Mask with sliding window

The mask was constructed of posterboard and was covered with a deep black velvet cloth to help absorb the light, thus cutting down on flair entering the system.

The first attempt to build an estimating unit consisted of a copyboard, a 35 mm single lens reflex camera, flood lights and a densitometer with a transmission head. The densitometer was mounted onto the viewfinder in the camera. The phototube in the densitometer head was exactly the size of the lens in the viewfinder. The camera and densitometer were held above an illuminated copyboard using a copystand. (See Figure 6).

When this scheme was tried the unit did work to the extent where a deflection on the densitometer scale was recorded. Further investigation revealed that the unit did not yield equal readings for a given density across the copyboard slit. In order for the unit to give true estimates of image areas, readings must be the same throughout the slit being read. For example, if slit number three (corresponding in ink key number three) was being read, a piece of copy with the density of A (see Figure 7) must read the same value on the estimating unit no matter where it might be in that slit. As it turned out, this estimating unit yielded much higher density reading with copy placed in the center of the slit. The error from the center of the slit to the ends was one hundred percent. If copy was placed anywhere in between the center and the ends, the error was proportional to its

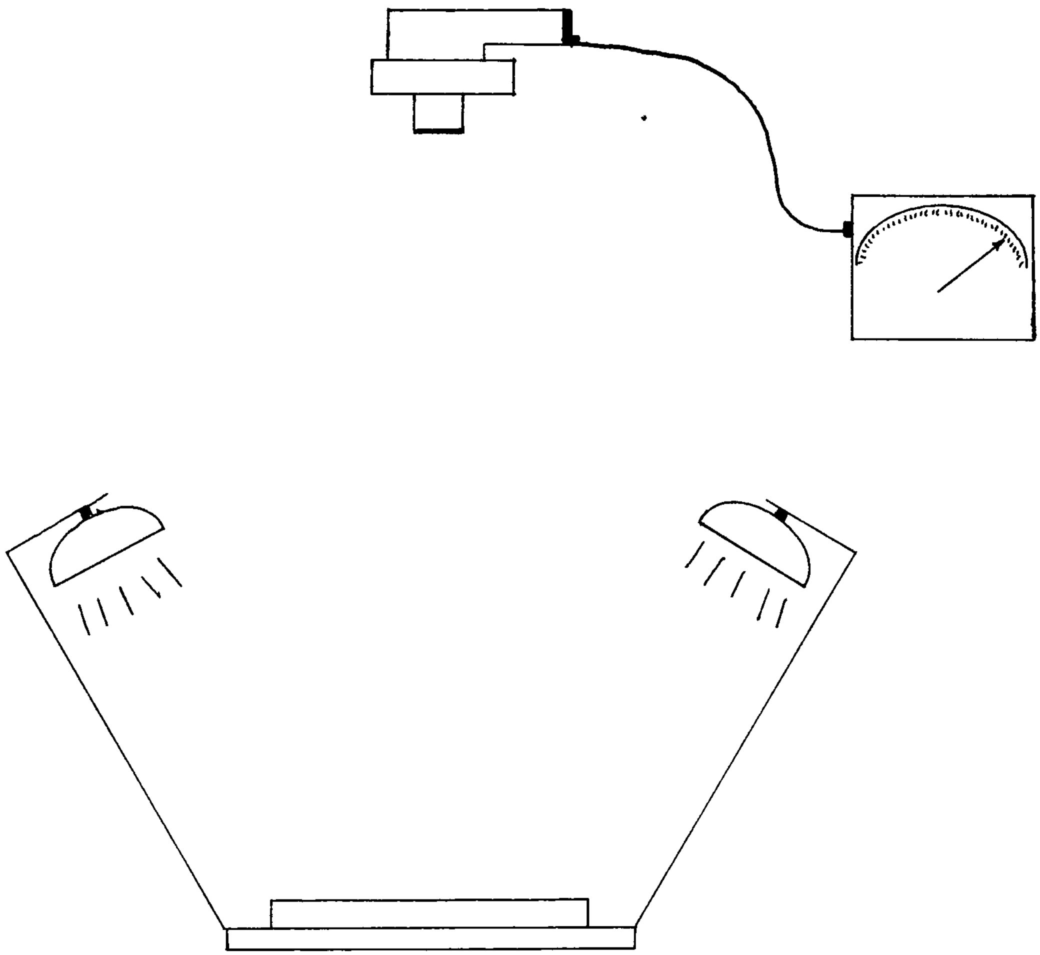

Figure 6. Original designed estimating unit (camera system)

location.

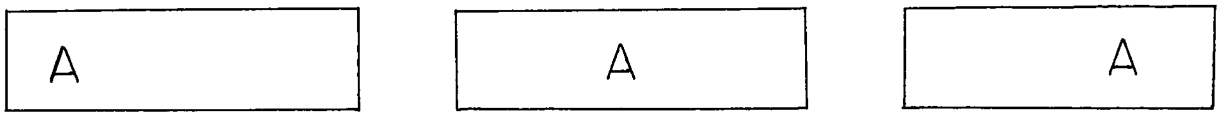

Figure 7. Placement of image area

The reason for this phenomenon could be theorized in the following way: Using an on-axis case (Figure 8) the light is incident on the Fresnel lens and ground glass.

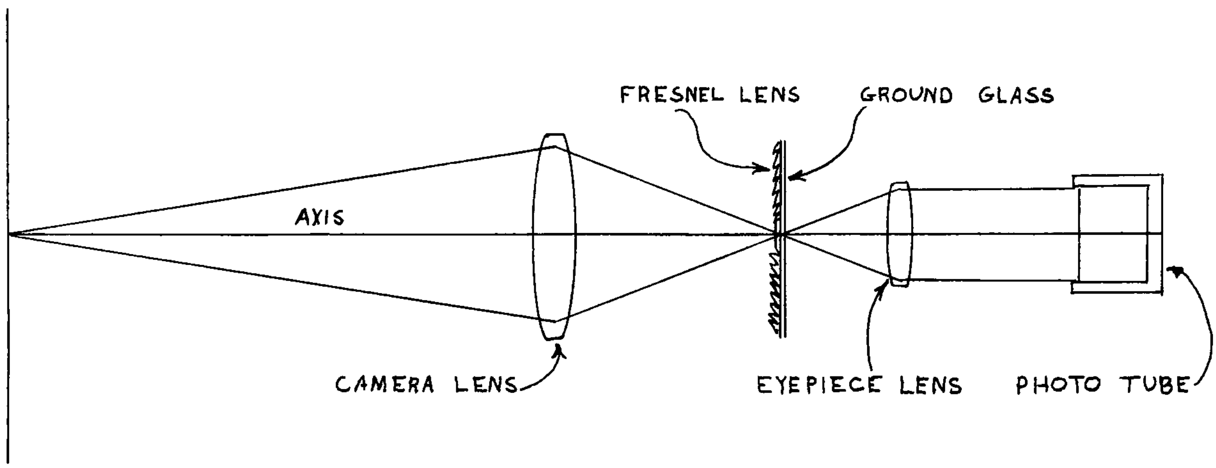

Figure 8. Camera system on-axis case

The eyepiece lens provides an image at infinity for viewing. The on-axis case works fairly well. There is some loss of light energy caused by the scattering of light from the ground glass but most of the light energy is projected on the surface of the phototube.

Using the off-axis case the light is incident at an angle on the Fresnel lens and ground glass. If it were not for the

Fresnel lens the light would be scattered toward point A (Figure 9) and it would be doubtful that any light would be collected through the eyepiece lens. When looking at ground glass off-axis the intensity always falls off. The function

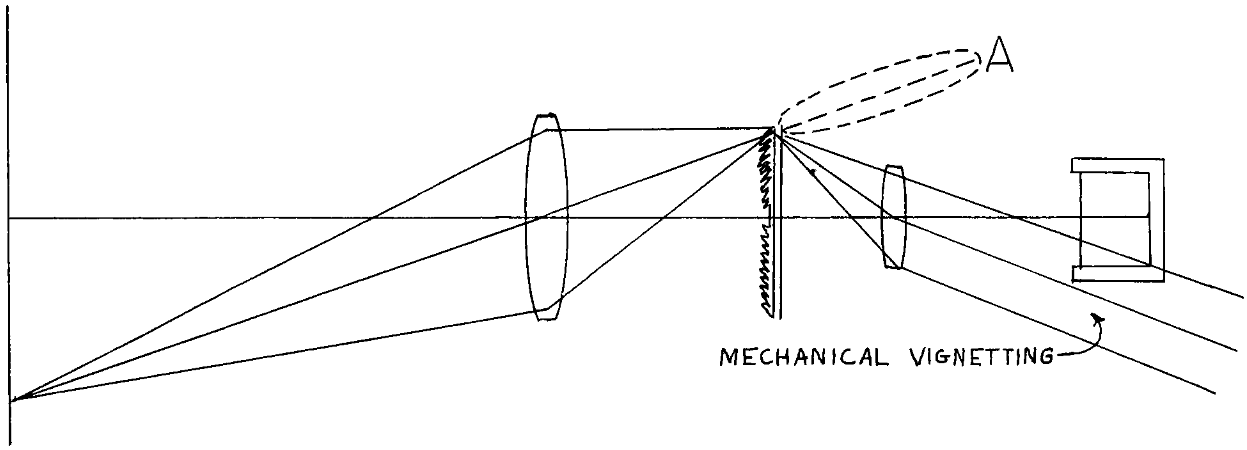

Figure 9. Camera system off-axis case

of the Fresnel lens in this situation is to try to redirect the cone of light from the camera lens to the ground glass so that most of the light passes through the eyepiece lens. Again this is dependent on the efficiency of the Fresnel lens. If the assumption is made that the Fresnel lens efficiency is the same for both the on and off-axis cases, it can be considered not a factor in this study. Assuming that all light is redirected by the Fresnel lens off-axis onto the eyepiece lens, notice how the light beam travels when leaving the magnifying lens, (Figure 9).

Because of the physical characteristics of the camera and the photo cell being used it was impossible for the phototube and the eyepiece lens to be in contact with each other. This space causes a mechanical vignetting of the off-axis light beam. As these beams vignette the amount of energy that can be collected on the surface of the phototube goes down, thus giving the unwanted variation across the slit.

A new system had to be designed where there is no vignetting problem. In this system the ground glass was eliminated and replaced with a field lens. (A Fresnel lens was not used as the field lenses in this design).

The camera lens used was a standard 135 mm focal length 35 mm format camera lens which formed a real image. Behind the camera lens a field lens was placed. The field lens takes the exit aperture of light from the camera lens and focuses it directly on the phototube. The focal length of the field lens was adjusted to fill the entire area of the phototube. This on-axis case (Figure 10) is almost identical

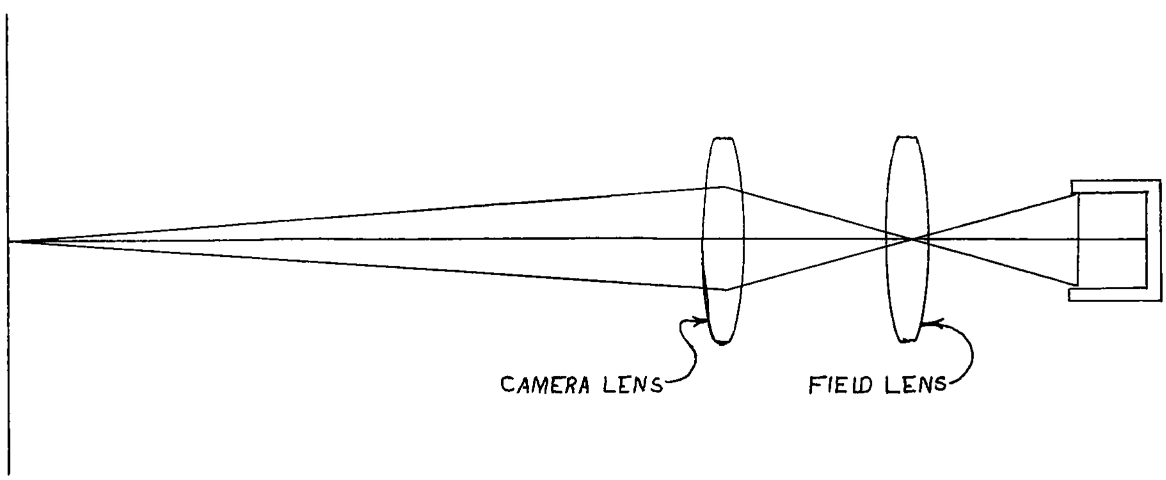

Figure 10. Estimating unit on-axis case

to the camera system with the exception of the ground glass, and all light energy is collected.

The off-axis case is where this system and the camera differ. Again, as in the on-axis case, the light passes through the camera lens and is focused on the phototube by the field lens as a beam of light, (Figure 11). In this situation the mechanical vignetting problem that was present using the camera system does not exist.

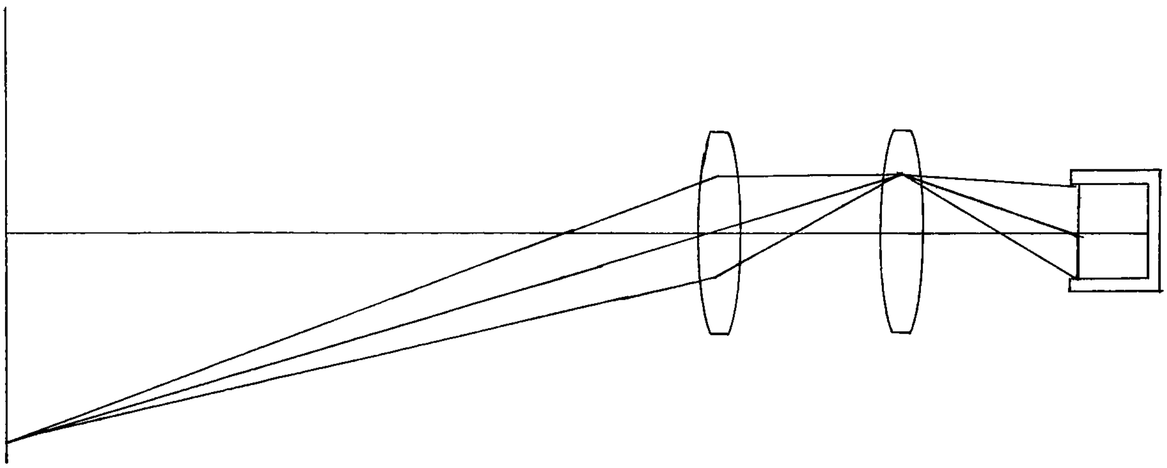

Figure 11. Estimating unit off-axis case

There still existed the problem of illumination fall-off from the ends of the slit to the middle because the different distances from copyboard to lens, (Figure 12).

The distance A is shorter than the distance B. To help compensate for this the lens to copyboard distance was kept large to keep the angle 0 low. Using the $\cos^4$ law, the off-axis illumination fall-off should have been no worse than the fourth power of the cosine of angle 0 (providing there was no

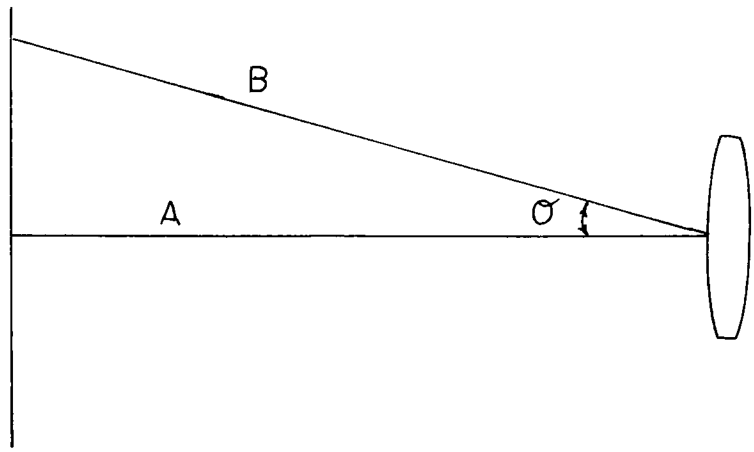

Figure 12. Cosine 4 law

mechanical vignetting). The calculated maximum error was found to be around 2% which was felt to be insignificant in this study.

Incorporated in this system was a mask, placed in contact with the field lens. This mask had a clear slit of one inch long by .054 inches wide and was placed on-axis with the copyboard, camera and field lenses and the phototube. This slit is slightly larger than the image that will pass through onto the phototube. A black velvet mask was also fitted on the copyboard with a cutout of .75 inches by 13.25 inches which corresponds to the area in which an ink key is responsible. The purpose of these masks is to cut down on the amount of stray light that enters the system from the surrounding and thus affect consistency of the estimating unit. Also to help control stray light, the entire lens system along with the phototube was placed in a light-tight black box with a baffle over the camera lens. (See Appendix B).

The components of the estimating unit were a Densichron densitometer model used for the phototube and meter movement. The field lens was taken from a standard 35 mm slide projector. The 135 mm f/4.5 Steinheil was used because of availability, image quality and flatness of field along with the ability to keep the angle O low. To use this size field lens, the image going through the lens, had to be reduced to just under one inch. Through calculations, it was determined what f-number field lens had to be chosen. The formula used was:

$$\text{f-number} = \frac{f}{b}$$

Where the f-number of the lens is equal to its focal length divided by its diameter. The f-number needed for the field lens had to be one that was readily available taking into account the maximum area of the phototube and using a 135 mm lens. The lens from the slide projector was just the right size for an image of about one inch because of its design for use with 35 mm slides.

To find out where the lenses were to be placed, a series of calculations had to be performed. The width of the slit on the copyboard was approximately fourteen inches. To reduce this down to under one inch, it was reduced sixteen times. To find out the object to lens distance, the following formula was used:

$$S = f\ (1 + \frac{1}{M})$$

Where S is the distance, f is the focal length of the lens and M is the magnification. Before this equation can be solved, the magnification must be computed. The formula

$$M = \frac{h'}{h}$$

was used where h' is the image size and h the object size. In this case, one object size (h) was .875 inches and the image size, fourteen inches. The magnification was one-sixteenth.

Using the formula $S = f\ (1 + \frac{1}{M})$ the calculated object to lens distance is 229.5 cm. To find the lens to image distance the formula

$$S^1 = f\ (\ 1 + M)$$

is used. After calculation the distance is 13.5 cm. The placement of the phototube was determined empirically. This was done by using a piece of ground glass and moving it on axis until the beam of light from the field lens was .625 inches in diameter. The phototube was then placed in the system at that point. The distance was found to be 13.5 cm, (Figure 13).

Procedure

Before any readings could be taken on the estimating unit different types of copy had to be prepared. For the calibration tints 100 line tint screens were chosen. The percentages of these tints ranged from ten percent upwards to eighty

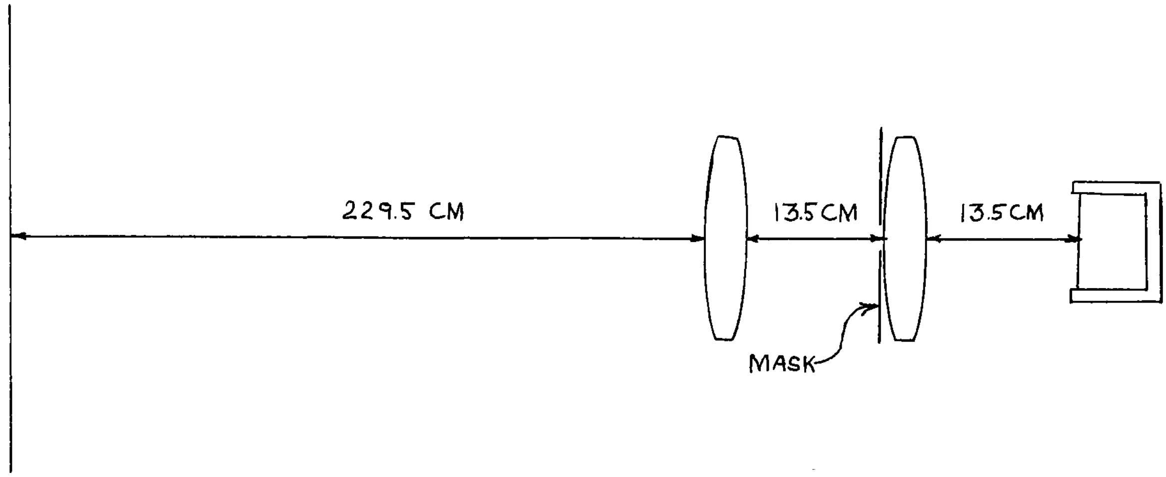

Figure 13. Calculated lens placement

percent. Because of press characteristics a ninety percent tint was not printed. It was believed that this tint might print as a solid because of dot gain. Also, a solid was not made, again because of the presses' inability to print such a large solid to the density required without ghosting or starvation occurring. With a total of eight tints to be read it was felt to be sufficient for the determination of the required curves and to allow a regression analysis (line of "best fit") which will later be used in the actual pre-setting of the ink keys.

The tint screens were of a negative type. Each screen was then contact printed on a sheet of Kodak Ektomatic "T" paper. The paper was developed in stabilization chemistry, fixed, washed and dried.

The sample copy used in this study was a combination of line and halftones. The line copy was selected randomly from negatives already made in various reproduction photography classes. The halftone negatives were donated by the Batavia Daily News of Batavia, New York. These halftones were well suited for this study because of the screen ruling used and both the highlight and shadow dot areas. The screen ruling of the halftones were 110 lines per inch and the dot areas in the highlights were approximately ten percent, the shadow areas ranged from eighty-five to ninety percent. With half-tone negatives with the above characteristics, it was assumed that the Chief 15 could reproduce a quality halftone picture.

All sample negatives were stripped into flats to later be used for making plates and contact prints. A variety of different image arrangements were made. Some flats contained only halftones, some strictly line work, while others had a combination of the two. In order to test the effectiveness of the method of pre-setting the ink keys, different image arrangements - in terms of percent printing area - were tried. For example, large image areas were placed next to areas that would require little ink. These arrangements not only varied across the sheet, but around the printing cylinder. (See Appendix A)

After ten flats were assembled they were contact printed so to be read by the estimating unit. Again, Ektomatic "T" paper was used in the same manner as when the screen tints were contact printed.

A control patch was placed on all contact prints. These patches were located in the same position for each tint and sample.

Plates were made from the flats and the control patches were also exposed on the plate. The control patch was .25 inches square. This patch when being printed was monitored to account for the solid ink density of the sheet to check if specifications were being met. There was one patch for each ink key and it was located in the center of the area for which an ink key was responsible.

For convenience, the format size of the tints as well as the samples were 8.5 inches wide by 11 inches long. Because of this the first and thirteenth ink keys were not used in this experiment and were in an off position during each of the press runs. It is assumed that while only eleven ink keys were used, the study is valid and the hypotheses can be tested.

The copyboard in the estimating unit was equipped with register pins to keep the copy in the correct position during the readings. The copyboard had markings for the center of the sheet in the direction of sheet travel through the press. (See Figure 14). This design is similar to the feedboard on the Chief 15. Because of this all sheets were placed in the center of the estimating unit and thus would be placed in the center of the press when being printed. As in the case of the 8.5 inch by 11 inch form, the two outer-most slits of the

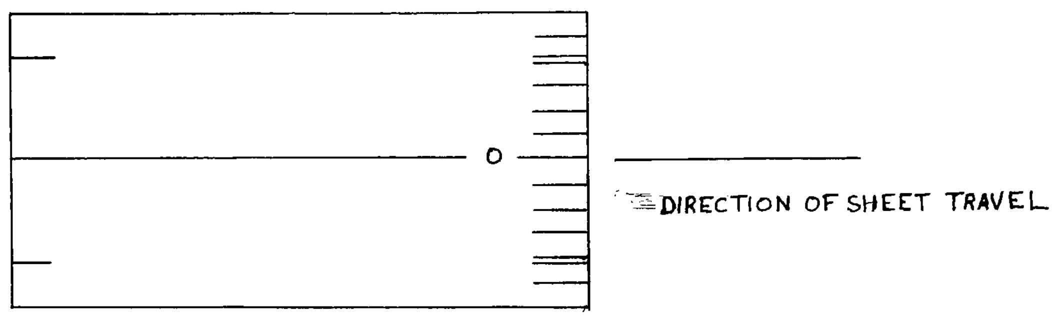

Figure 14. Copyboard

estimating unit would read zero and the ink keys that correspond in those slits would be off.

Before any readings were taken, a piece of Ektomatic "T" paper that had not been exposed but developed was placed in the estimating unit and the unit (the scale) was zeroed out on that paper. This should be done for any type of paper, be it a press proof, copy from a phototypesetter or otherwise. This was done to calibrate for the variation in density between stocks used for paste ups.

A screen tint was placed in the estimating unit in the area corresponding to the second ink key (keys one and thirteen were not used in the study). The slit was moved on-axis with the estimating unit's optics. Each of the eight tints were read once through and then repeated to check for repeatable results. Each time a new slit area was read the copyboard mask was moved and the slit was placed on-axis with the estimating unit. Once the tints were read, the ten sample copies were read in the same manner. All readings were recorded.

From the readings acquired a curve was drawn showing the relationship of percent tint to the integrated density determined by the estimating unit.

After press maintenance was performed, the press was set up for the printing of the screen tints. The ten percent screen tint was the first printed. The ink keys were adjusted to where the solid ink densities of the .25 square inch patch was brought in spec. The densitometer was used to measure the patch. The sheet was also checked visually for quality (little dot gain, scumming, washout). The dwell times for the ink and fountain solution rollers were also adjusted as conditions dictate. Whenever an adjustment was made for the ink or fountain solution or if the press was stopped and restarted a minimum of 100 sheets were printed before a sample was taken to be evaluated. This was done to allow the press to become stable. This was done on all press runs during the entire study.

Once the patches were brought into spec the press was allowed to run for at least 100 more sheets and five more samples were taken to verify that the press was stable. All readings were averaged for each ink key and recorded.

When the press was stopped the dials were placed on all ink keys at the zero position. The reason for not fastening the dials to the keys before the press run was to eliminate the problem associated with using feeler guages to obtain uniform blade to fountain roller distance at each ink key for equal discharging of ink to the remainder of the inking system. This method takes into account bowing or nicks in the rollers which might effect ink feed.

The remaining tints were then printed by opening only the ink keys. The ink dwell of the fountain roller to the oscillating roller was kept constant at all times. If necessary the amount of fountain solution was increased or decreased according to demand. When spec was achieved the next tint was printed. All dial readings and solid ink densities were recorded. (See Table 3)

Using the procedure immediately discussed, data was obtained to allow curves to be generated. These curves plot the percent tint vs ink key setting. These curves were generated in the following manner:

(1) Integrated density measurement was taken from the estimating unit.

(2) The percent tint was found using figure 15. (relationship of integrated density to percent tint).

(3) The individual tints were printed and the dial readings were recorded for each ink key when a quality print was obtained.

(4) The percent tint was plotted vs the ink key setting obtained for that print,

(Figures 16 through 26).

Because the points do not fall on a perfectly straight line, a line of "best fit" had to be drawn. This line is the approximation of where the line should have been if there was no variability in the process. This was done by using the data received from the press runs and mathematically finding the slope and intercept to find the equation of the line of best fit. This line of "best fit" would now be known as a regression line and used as follows:

> We are often interested in a possible relationship between two or more variable quantities. We may suspect that when one of the quantities is changed, the other changes in some predictable manner. It is useful to express such a relationship in the form of a mathematical equation connecting the variables. If we can find the equation, we can then predict the value of one variable from a knowledge of the value of the other variable or variables. [6]

Before any ink keys were pre-set to the regression line for the sample prints, the prints were printed in the usual "educated guess" method. Before each printing the ink keys were brought to the zero position on the dials. The ink fountain dwell was kept constant at the fourth mark. The dampening fountain dwell was adjusted, but only when catching up or washing out occurred that could not be remedied by adjustment of the ink distribution keys. The purpose of this test was to determine whether the "educated guess" method yields the same dial settings, when brought into spec, as the curve of the predicted dial settings from the regression lines.

Once this test was complete the ten samples were again printed, but this time the predicted dial settings from the regression lines were used. In this test to determine whether or not the key settings were correctly set, the inking and dampening dwell times were adjusted. If, by this method a sample could not be brought into spec, the keys that needed adjustment were adjusted, and the deviations recorded.

From these tests it would indicate if the pre-setting of the ink distribution keys is possible using the above method.

FOOTNOTES FOR CHAPTER II

[1]Harry H. Hull, "The Theoretical Analysis and Practical Evaluation of Roller Ink Distribution Systems," T.A.G.A. Proceedings (1968), p. 291.

[2]Ibid.

[3]Bruce F. May and Julius Silver, "The Pre-setting of the Ink Distribution Keys on a Small Sheetfed Offset Press," (Masters Thesis, Rochester Institute of Technology, 1974). p. 37.

[4]Ibid., p. 2.

[5]Roger Ynostrozo, "Remote Control of Ink Fountains on Sheetfed Offset," Graphic Arts Monthly (May 1973), p. 67.

[6]Albert D. Rickmers and Hollis N. Todd, Statistics, (New York: McGraw-Hill Book Co., 1967) p. 239.

CHAPTER III

RESULTS

All readings taken from the estimating unit were taken with room lights out to help further reduce flair from entering the system. Before any readings were taken the densitometer had ample time to warm up and the unit was zeroed out on a piece of "T" paper. The screen prints were the first pieces to be read. Each ink key area was read twice to check for any variability. Each time a reading was taken the result was recorded (see Table 1). For each percent tint there was a total of twenty-two readings (each of eleven "key areas" were read twice). The average of these twenty-two readings were calculated and was used for construction of curves. For any screen tint the readings should have been identical for each ink "key area". There was, however, some variation (.01 units). This could be attributed to a variety of factors. The tint screen may have been smudged when contacted to the "T" paper, presence of dirt on the glass of the contact frame, or perhaps uneven development of the print. Other possibilities could be parallax (the unit contained a needle pointer on the scale for readout, see Appendix B), or the mask not being placed on axis with the optical system correctly.

For each tint an average integrated density reading was obtained (see Table 1). The percentage of the tint was plotted against the corresponding average integrated density reading. The resulting curve of percentage tint vs average density reading is shown in Figure 15.

The ten copy samples that were used for the test was next read in the estimating unit. Again, each ink key area for each sample was read once, and then replicated for a check. There was some variability but only in the area of .01 units. This could have been attributed to parallax or positioning of the mask. The average of the readings (two) for each key and sample number was calculated for future use (see Table 2).

For calibration of the ink fountain, the eight screen tints were printed. The ten percent tint was first printed, the dials were placed in the zero position. The other tints were then also printed. The tints were printed to the specifications previously stated to a minimum dot gain as possible (done visually) and a solid ink density of the .25 inch patch of between .90 and 1.20 with a variation of .20 for a given sheet. All readings were taken within thirty seconds of the printing. When the press was considered in control and the printed sheet in spec the press was shut off and the dial readings were read. The dial readings and the solid ink densities are found in Table 3. The ink dwell for all these press runs remained constant throughout all the

TABLE 1.

Integrated Densities of Calibrated Tints

Percent Tint

Key Number #	10%	20%	40%	50%	60%	70%	80%
2	.05	.12	.22	.26	.32	.40	.46
3	.05	.12	.21	.26	.33	.40	.46
4	.05	.12	.20	.26	.32	.40	.46
5	.05	.12	.21	.26	.34	.40	.46
6	.05	.12	.22	.26	.34	.40	.45
7	.05	.12	.21	.26	.34	.42	.46
8	.04	.12	.22	.26	.34	.41	.46
9	.05	.12	.22	.26	.33	.40	.46
10	.05	.12	.21	.26	.33	.40	.46
11	.05	.12	.21	.26	.34	.40	.46
12	.05	.12	.22	.27	.34	.41	.48
2	.05	.12	.22	.26	.33	.40	.46
3	.05	.12	.21	.26	.33	.41	.46
4	.05	.12	.21	.26	.33	.40	.46
5	.05	.12	.21	.26	.33	.40	.46
6	.05	.13	.22	.26	.34	.40	.46
7	.05	.11	.22	.26	.34	.42	.46
8	.04	.12	.22	.26	.34	.41	.46
9	.05	.12	.21	.26	.34	.40	.46
10	.05	.12	.21	.26	.32	.40	.46
11	.05	.12	.22	.26	.33	.40	.46
12	.05	.12	.22	.27	.34	.41	.47
Avg.	.049	.121	.215	.261	.334	.405	.462

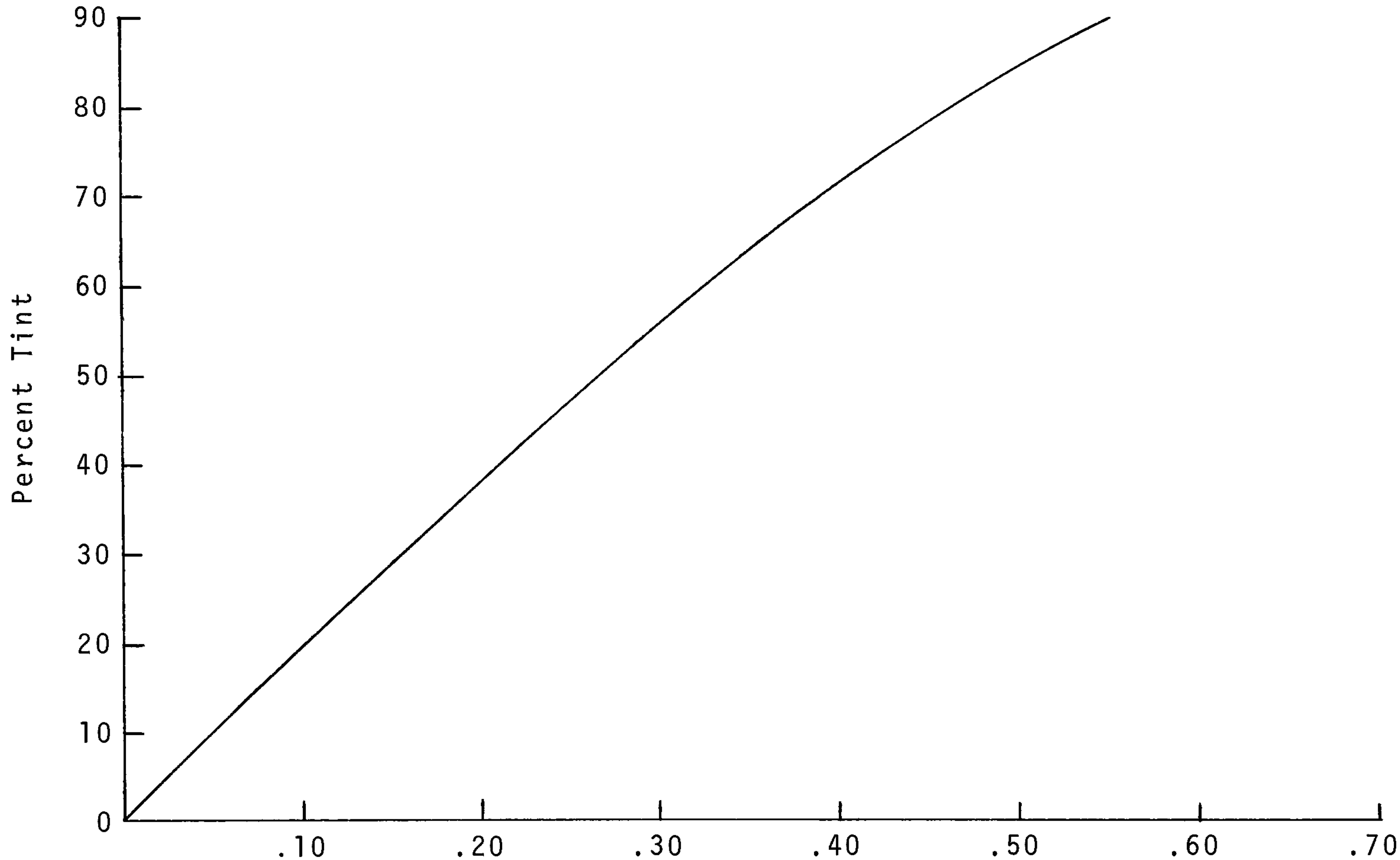

Figure 15. Integrated density vs percent tint

TABLE 2.

Integrated Densities of Sample Copy

Sample Copy

Key Number

#	1	2	3	4	5	6	7	8	9	10
2	.03	.02	.04	.01	.05	.04	.12	.08	.01	.07
3	.11	.03	.27	.02	.08	.08	.18	.12	.03	.08
4	.12	.04	.24	.02	.06	.08	.14	.14	.04	.07
5	.10	.06	.22	.12	.04	.06	.16	.10	.05	.10
6	.10	.06	.14	.12	.04	.06	.16	.09	.04	.10
7	.07	.04	.14	.14	.06	.05	.24	.16	.06	.12
8	.06	.01	.14	.03	.06	.04	.20	.10	.06	.15
9	.03	.00	.18	.14	.04	.06	.18	.14	.02	.01
10	.05	.20	.18	.04	.04	.07	.16	.16	.04	.02
11	.10	.22	.22	.05	.08	.06	.08	.12	.05	.05
12	.03	.04	.08	.02	.04	.10	.11	.08	.02	.02
2	.02	.01	.04	.01	.05	.04	.12	.08	.01	.06
3	.11	.02	.27	.02	.08	.08	.18	.12	.03	.08
4	.12	.04	.24	.02	.06	.08	.14	.14	.09	.07
5	.10	.06	.22	.11	.04	.06	.16	.10	.05	.09
6	.10	.06	.14	.12	.04	.06	.16	.09	.04	.10
7	.06	.04	.14	.13	.06	.04	.24	.16	.06	.12
8	.06	.01	.14	.02	.06	.04	.19	.10	.06	.15
9	.03	.00	.18	.04	.04	.06	.19	.14	.02	.01
10	.05	.20	.19	.04	.04	.08	.16	.15	.04	.02
11	.10	.22	.21	.06	.08	.07	.08	.12	.05	.04
12	.03	.04	.08	.02	.04	.10	.10	.08	.02	.02

TABLE 3.

Printed Densities and Key Settings of Calibration Tints

TINT	2 *	2 -	3 *	3 -	4 *	4 -	5 *	5 -	6 *	6 -	7 *	7 -	8 *	8 -	9 *	9 -	10 *	10 -	11 *	11 -	12 *	12 -
80%	17	.99	15	.96	20	1.00	21	.96	21	.96	20	.92	20	.92	20	.96	20	.91	19	.91	17	.93
70%	15	1.02	14	.99	19	.99	20	1.01	20	.98	18	.90	19	.90	18	.90	17	.90	15	.90	15	.90
60%	11	1.04	12	1.06	14	1.04	17	1.02	17	1.06	14	1.12	17	1.13	14	1.11	14	1.03	14	1.04	11	1.02
50%	6	.97	9	1.11	12	1.07	12	1.02	13	1.02	12	1.06	14	1.12	13	1.13	11	1.04	10	1.01	9	1.03
40%	5	1.03	6	1.08	8	1.07	10	1.03	10	.99	9	1.02	10	.99	11	1.13	10	1.09	8	1.12	6	1.13
20%	3	1.03	3	1.08	6	1.07	6	1.07	8	1.09	6	1.02	8	1.00	6	.99	6	1.09	3	1.03	2	1.08
10%	0	1.12	0	1.07	0	.98	0	1.03	0	1.00	0	1.11	0	1.00	0	1.03	0	1.02	0	1.12	0	1.11

* Key Setting　　- Density of Print Sheet Patch

press runs.

It should be noted that the ink key settings were not the same across the fountain for any of the tints printed. It was originally believed that the ends of the fountain would be required to open further than the center because of the dampening form roller squeezing the fountain solution outward. In this case the more water present at the ends, the more ink would be needed to attain a consistent solid ink density across the press sheet. In this study it was not the case. The dampenings form roller was bowed outward in the center. This did squeeze water to the ends as thought, but the roller was acting as an abrasive in the center and transferring ink from the plate back through the dampening unit. This action required more ink from the center of the fountain to be discharged.

Having the key settings of the eight tints along with the values of each tint these points were plotted for each ink key used. Ideally these points should have fallen on a straight line but because of process variability it did not. To help compensate for this variability a line of "best fit" was drawn. This line is an approximation of where the line should have been in the ideal case. Looking at the statistics (points) from the press runs the trend of the line appeared to be linear. To draw a line of "best fit" for this model, the slope and intercept of the line had to be calculated. The lines of "best fit" are shown in Figures 16 through 26 for each ink key used. The lines of "best fit" are, of course, different for each ink key because of the different values obtained from the press runs.

At this point it would have been conceivable to test if pre-setting of the ink keys was possible. But, before the test was carried out, another test was performed.

This test consisted of printing the samples by using the "educated guess" method. With the dial fixed on the ink keys and set to zero, the samples were printed. The operator had the option of either opening or closing any ink keys. He was instructed not to look at any of the dials as adjustments were made. During this test the ink dwell time was set at number four. The operator was not permitted to change the dwell setting. (A dwell time of four was used because when printing the first tint this dwell setting was used. In order to control this factor, it remained at that setting). The dwell for the dampening unit was adjusted but only when the ink key adjustment would not correct any ink-water balance difficulties. After each adjustment a minimum of 100 sheets were printed before a sample print was chosen for evaluation. After spec was achieved, the press was stopped and the dial settings recorded along with the solid ink density. Before the next sample was printed, the press was washed and more ink was added to the fountain. The fountain keys were brought back to the zero position for the next sample run. Table 4 has results of that test.

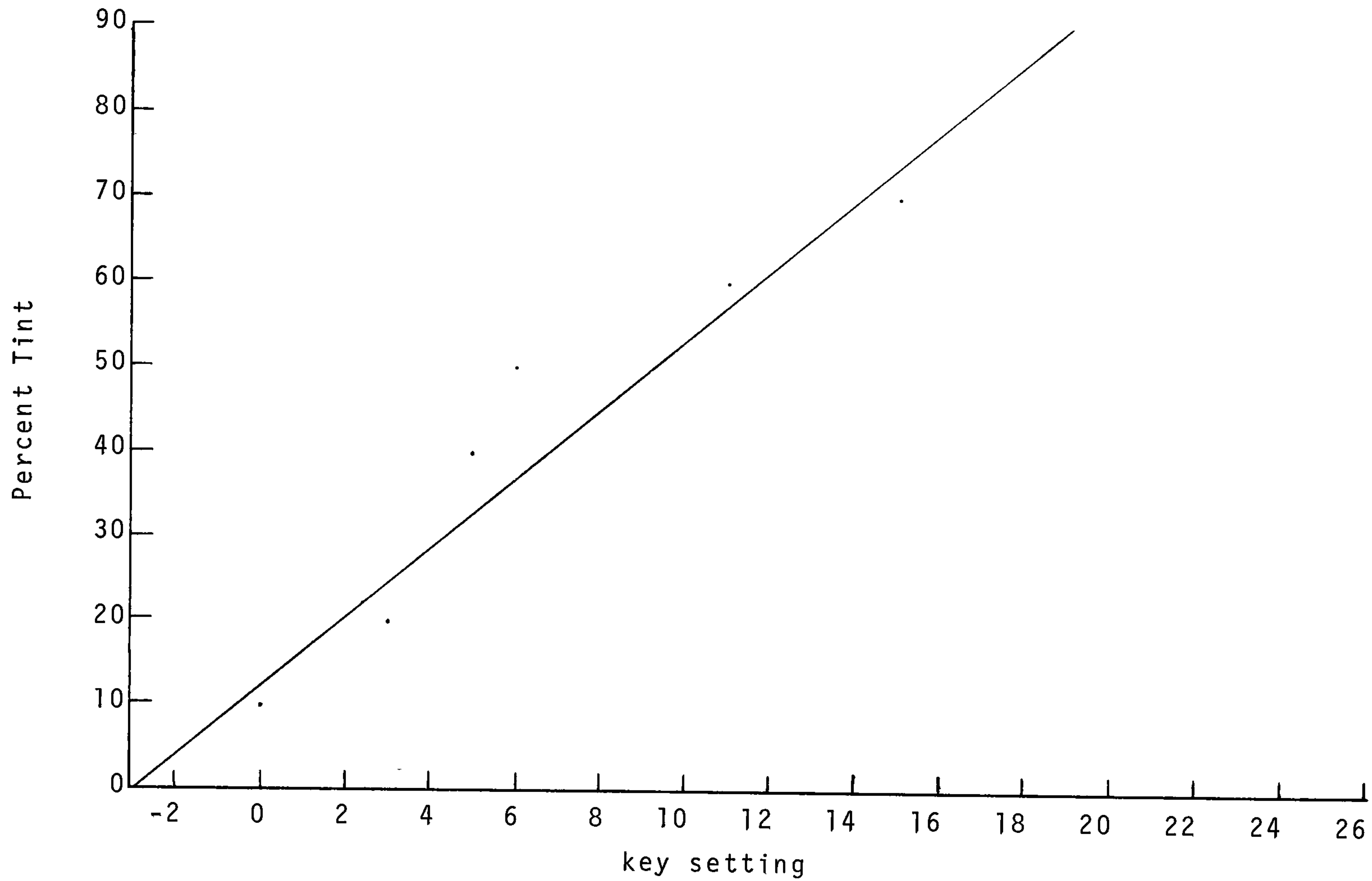

Figure 16. Line of "best fit" - key two

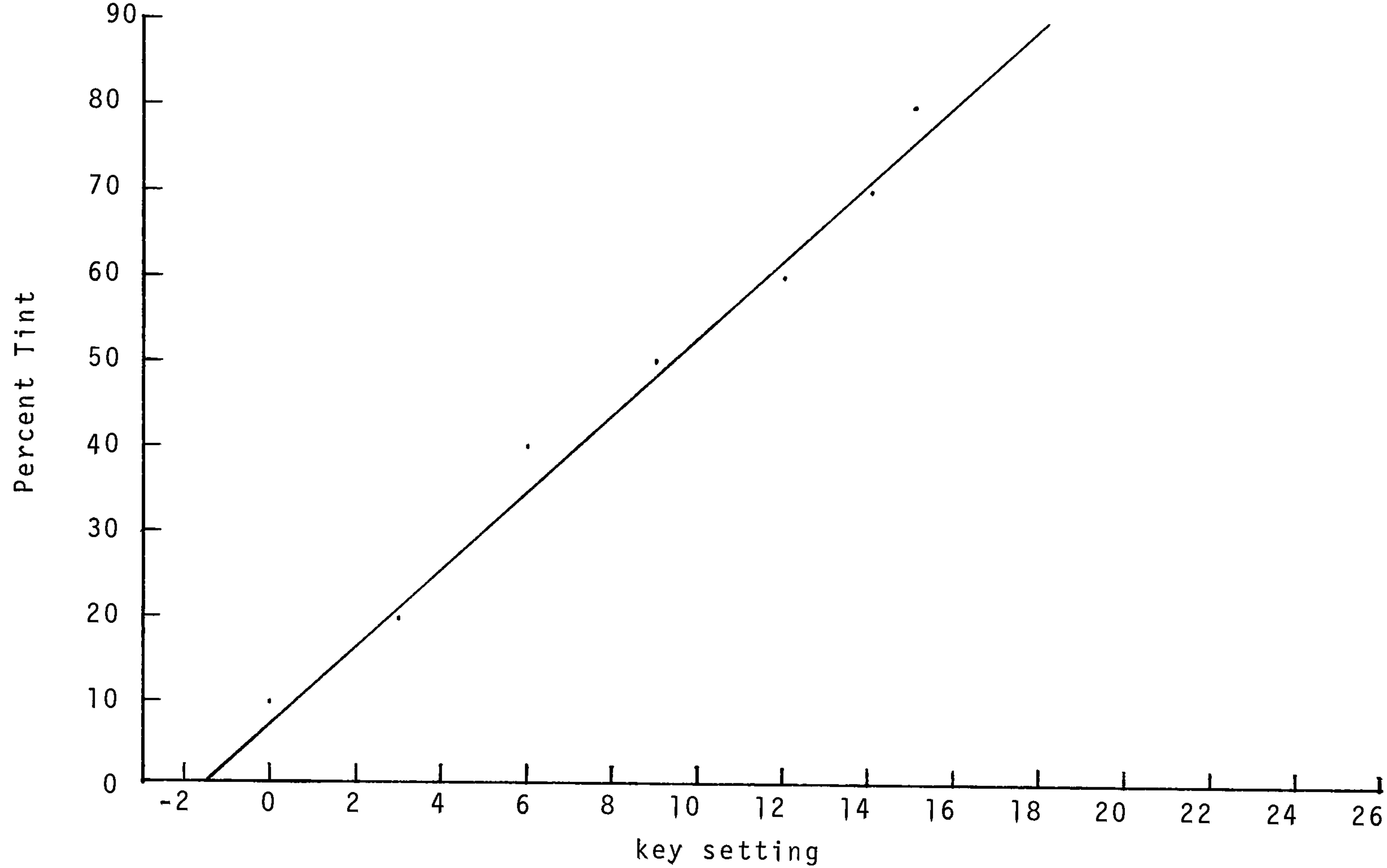

Figure 17. Line of "best fit" - key three

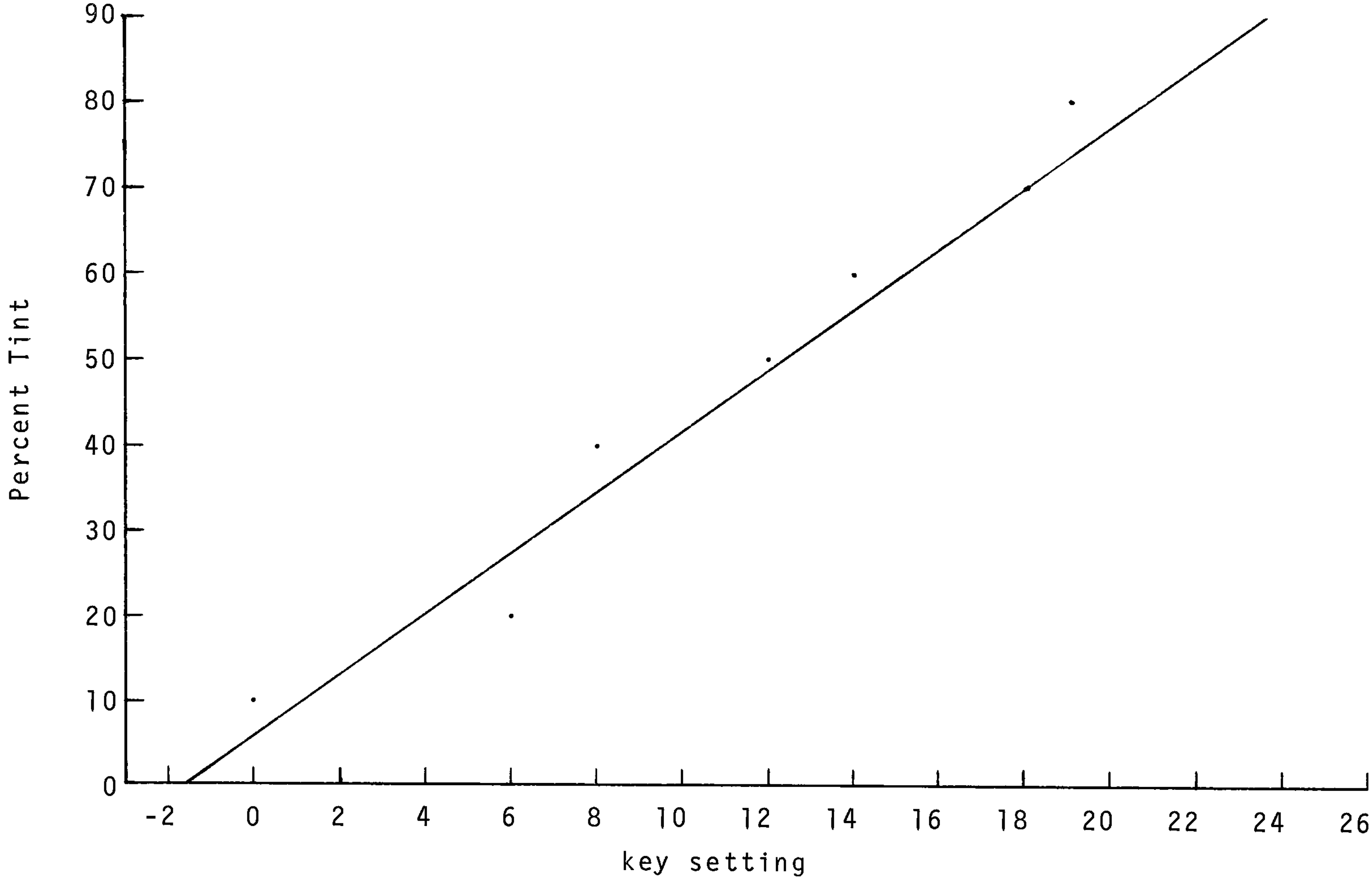

Figure 18. Line of "best fit" - key four

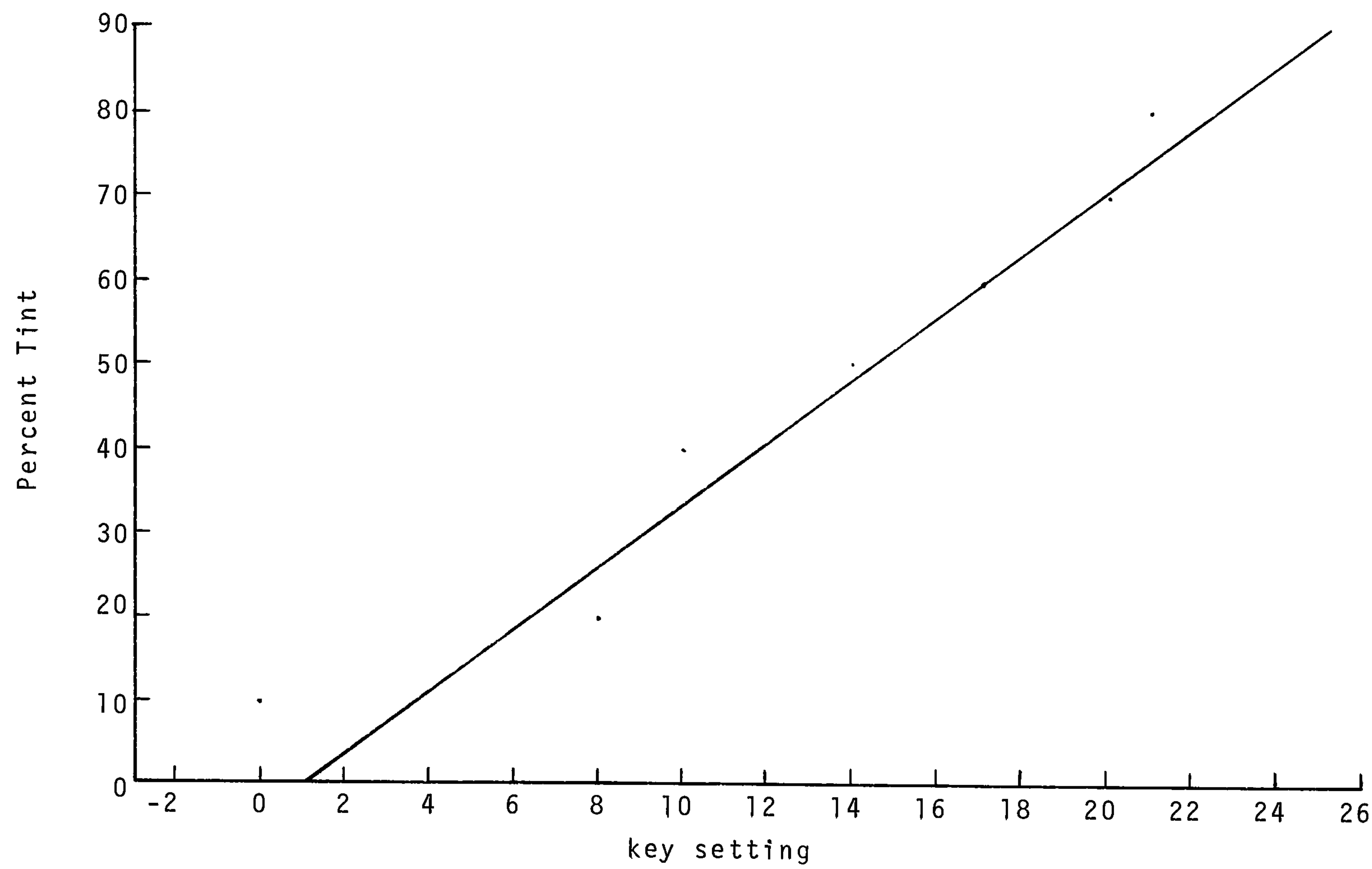

Figure 19. Line of "best fit" - key five

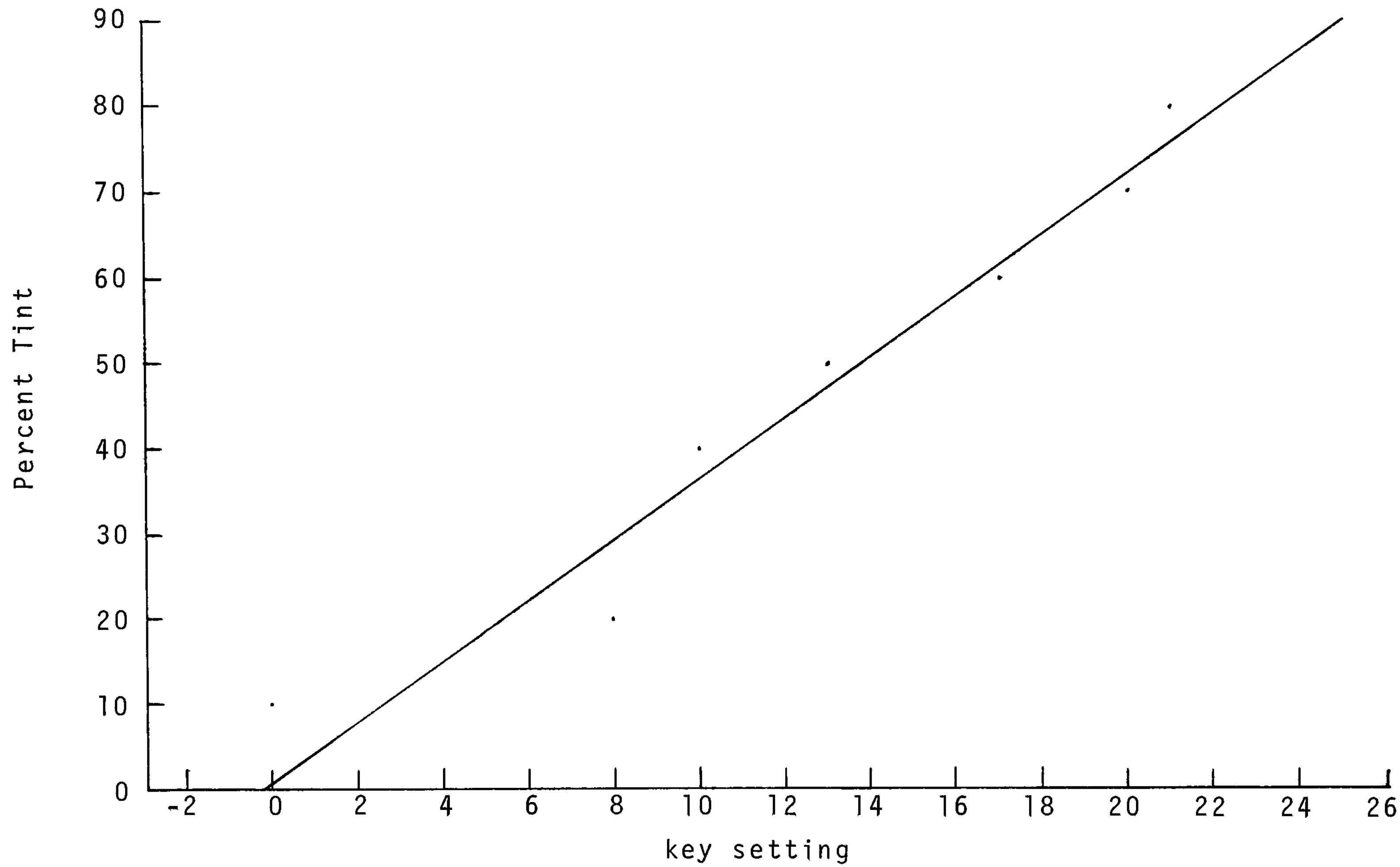

Figure 20. Line of "best fit" - key six

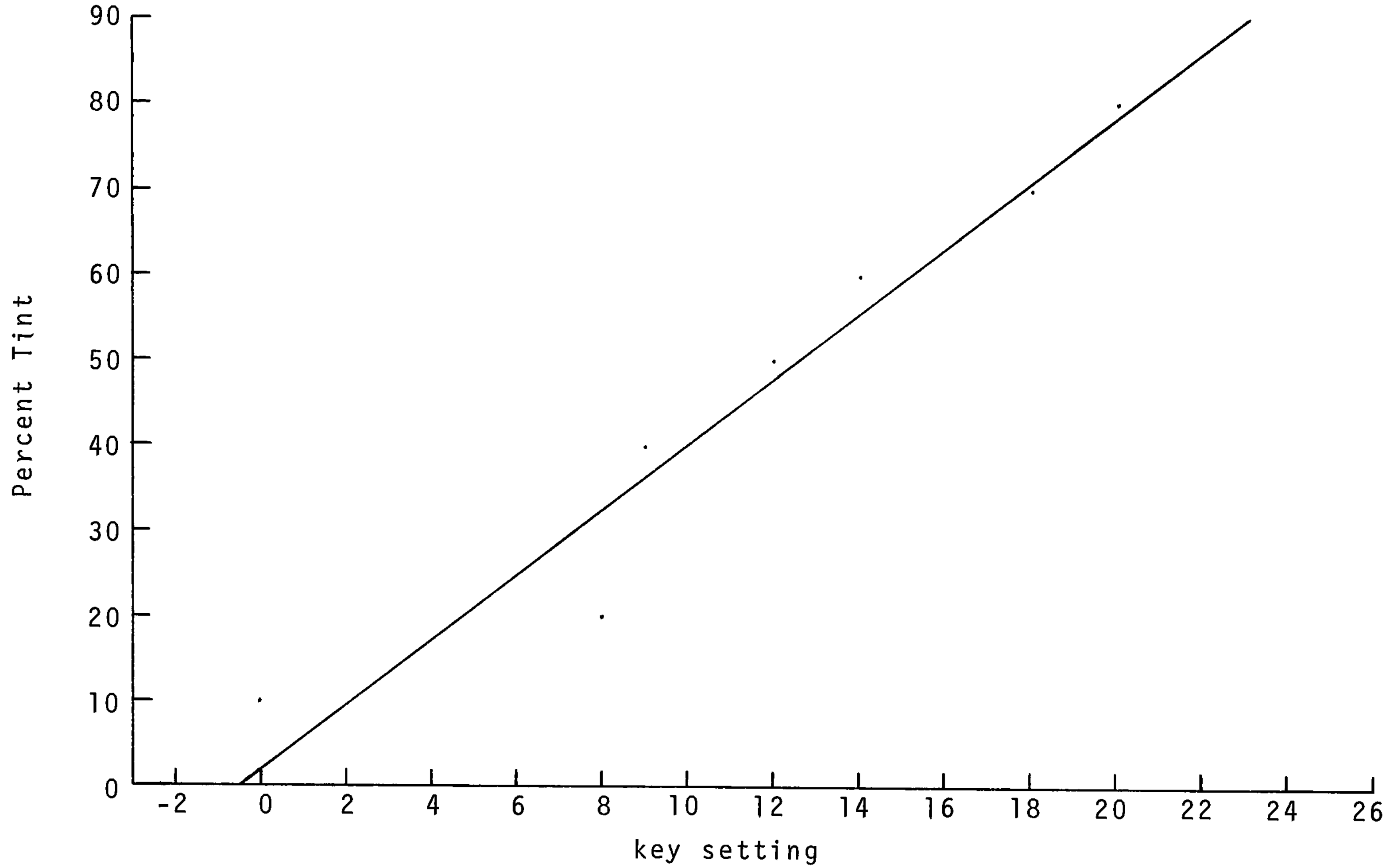

Figure 21. Line of "best fit" - key seven

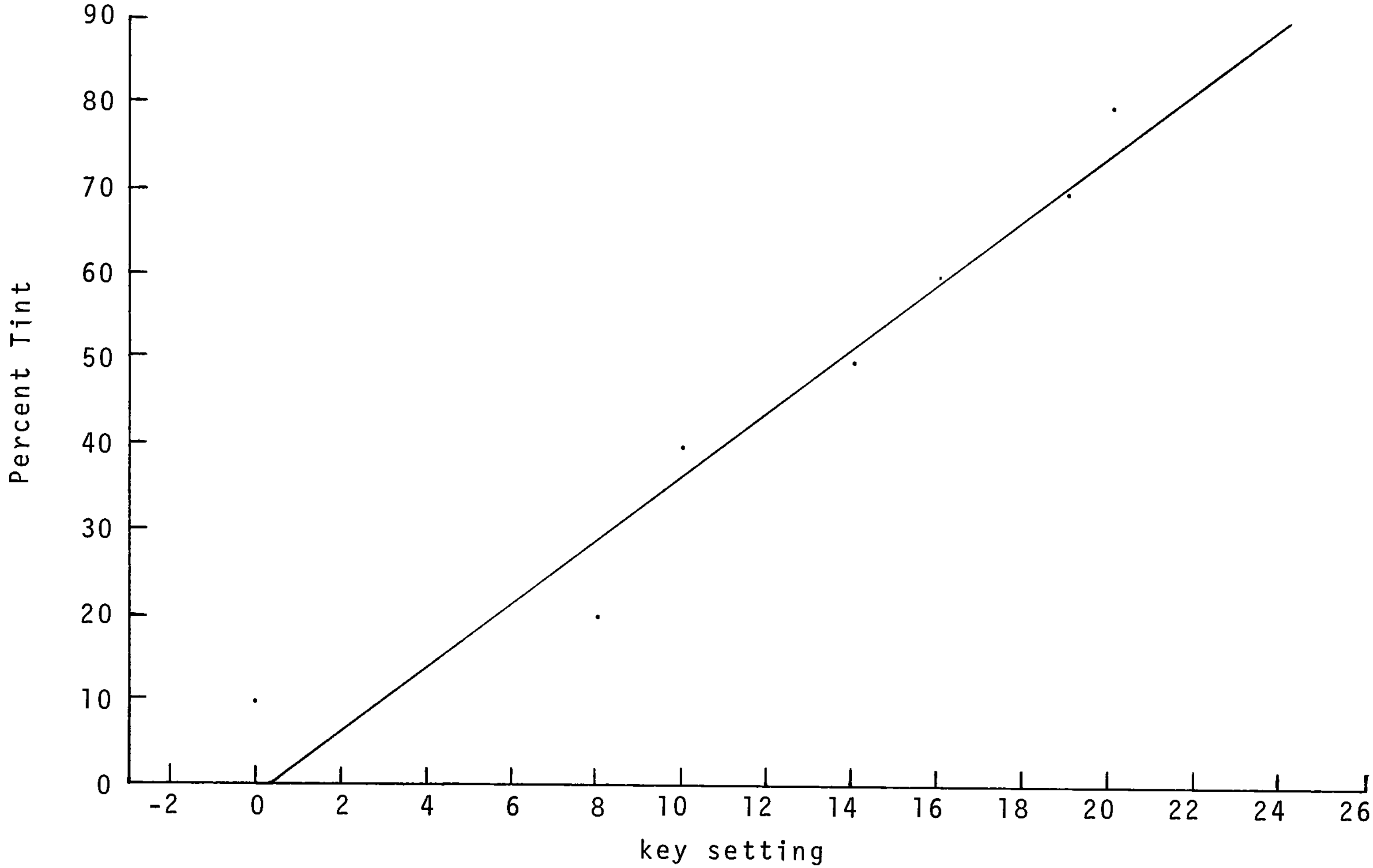

Figure 22. Line of "best fit" - key eight

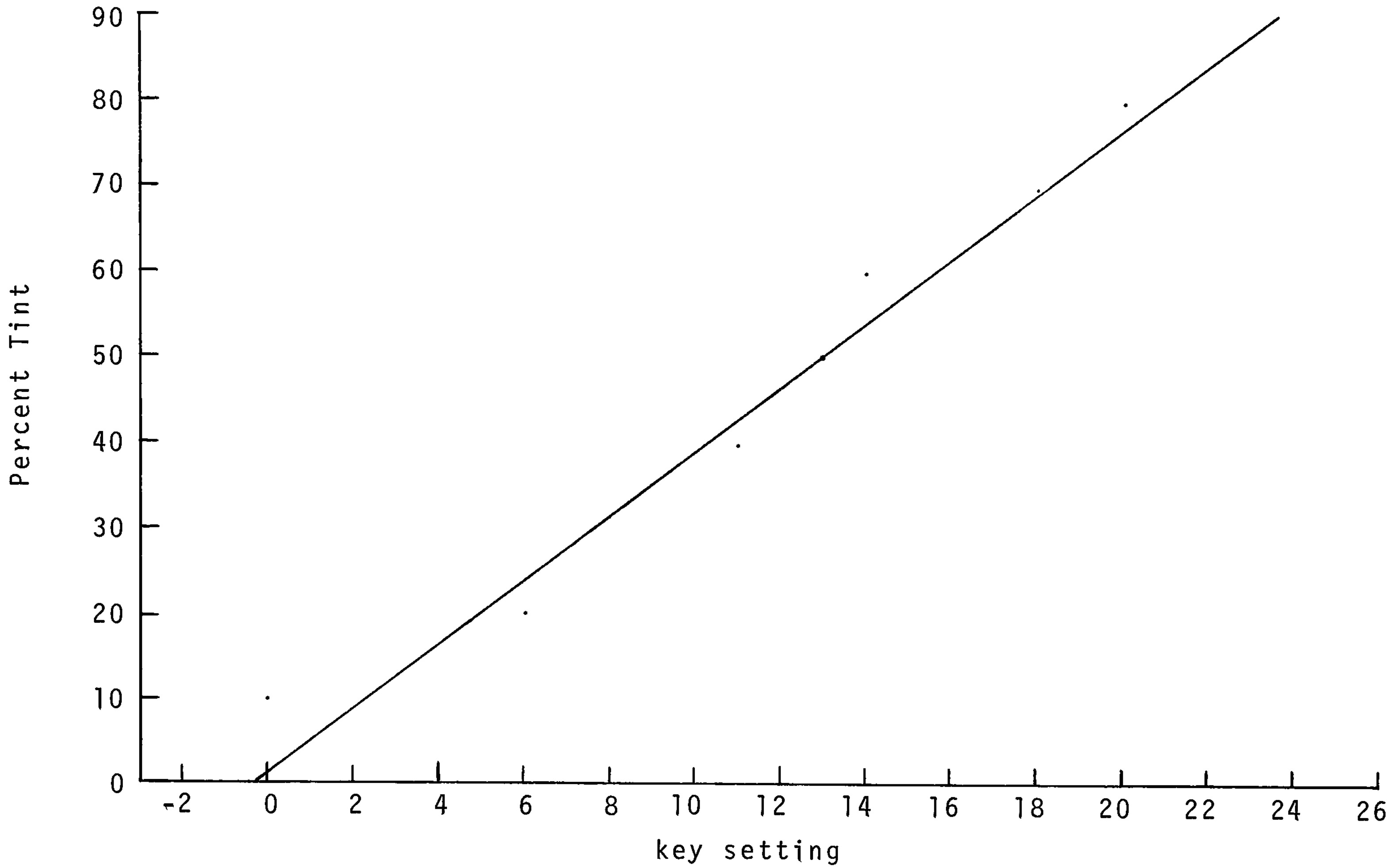

Figure 23. Line of "best fit" - key nine

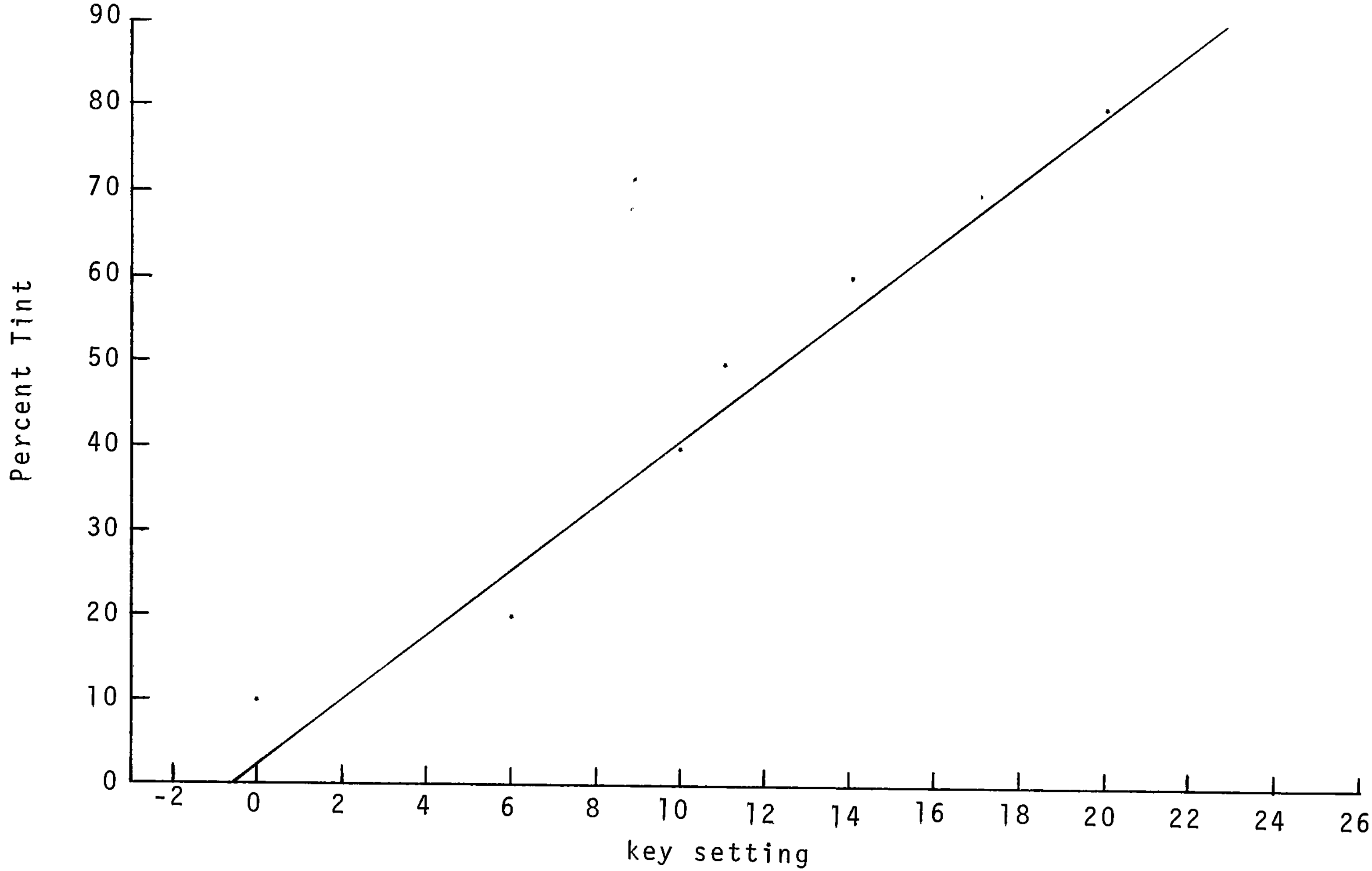

Figure 24. Line of "best fit" - key ten

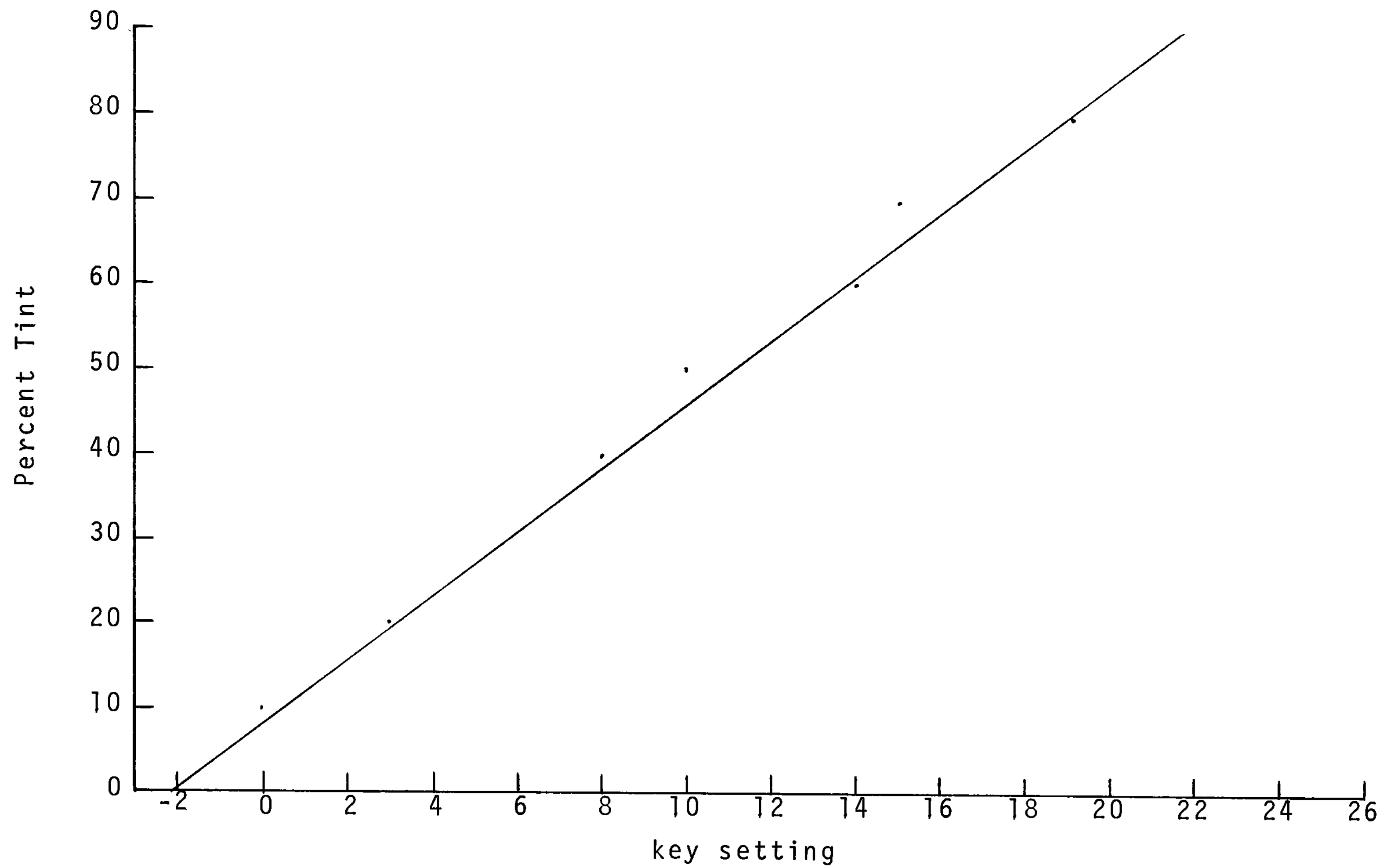

Figure 25. Line of "best fit" - key eleven

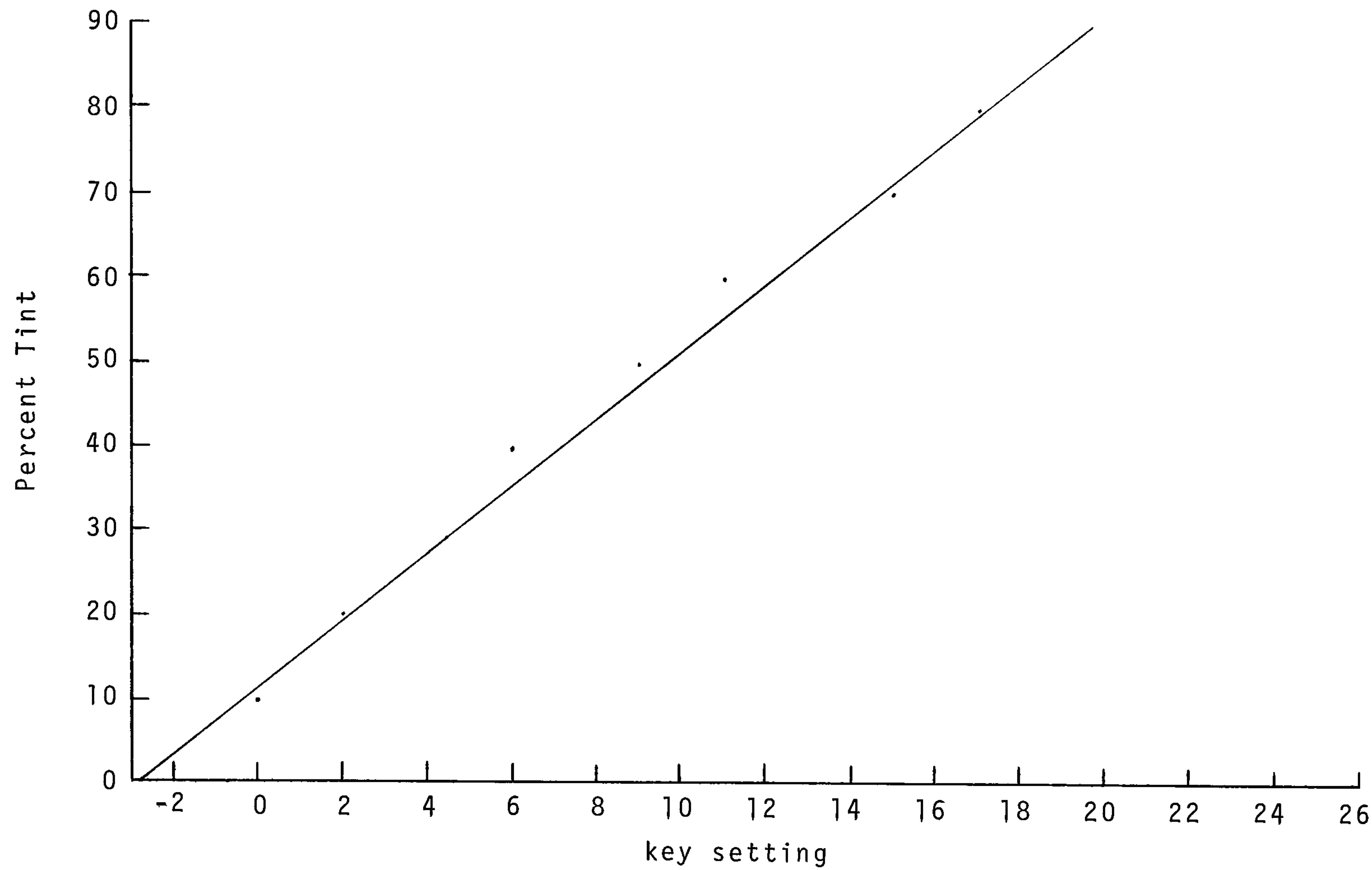

Figure 26. Line of "best fit" - key twelve

TABLE 4.

Printed Densities and Key Settings for Sample Copy

Key Number

#	2		3		4		5		6		7		8		9		10		11		12	
	*	-	*	-	*	-	*	-	*	-	*	-	*	-	*	-	*	-	*	-	*	-
1	1.08	1	1.00	2	1.00	4	1.00	5	1.00	6	1.00	3	1.05	5	1.08	6	1.13	4	1.07	1	1.11	1
2	1.14	-2	1.15	1	1.13	2	1.12	2	1.15	3	1.18	2	1.16	1	1.12	1	1.17	3	1.15	2	1.11	-1
3	1.08	0	1.03	5	1.09	7	1.04	7	1.02	8	1.02	6	1.12	8	1.04	7	1.05	5	1.03	3	1.04	-1
4	1.16	-2	1.12	-1	1.08	2	1.04	4	1.06	5	1.09	4	1.12	4	1.04	3	1.14	1	1.10	1	1.07	0
5	1.08	0	1.10	1	1.05	3	1.07	2	1.08	3	1.11	3	1.05	3	.98	3	1.02	2	1.05	1	1.06	0
6	1.09	-1	1.07	0	1.03	3	1.05	2	1.06	3	1.10	3	1.04	2	.94	3	1.02	2	1.08	1	1.03	0
7	.96	3	1.03	3	1.11	5	1.12	10	1.10	9	1.04	7	1.09	9	1.10	8	1.09	6	1.18	4	1.16	2
8	1.14	1	1.11	4	1.05	5	1.12	5	1.19	8	1.14	7	1.10	7	1.01	6	1.12	4	1.10	2	1.17	2
9	1.11	-1	1.14	0	1.15	3	1.08	3	1.09	4	1.06	2	1.10	5	1.01	5	1.12	2	1.05	0	1.01	-1
10	.96	1	1.17	2	1.11	3	1.11	3	1.12	4	1.07	3	.97	3	1.07	3	1.17	2	1.17	0	1.14	0

* = Density of Print Sheet Patch - = Dial Setting After Printing

The purpose of this investigation was to test if the "educated guess" method yielded the same ink key settings as the predicted settings, which at this point were not known. This was done to avoid influencing the results of the "educated guess" method.

If the settings of the "educated guess" method corresponded with the predicted settings, this would be one way of proving that the combination of the estimating unit and the calibration tints were indeed accurate for pre-setting ink keys.

All ten samples were printed. It was now desired to find whether the predicted ink key settings would match the actual settings. To do this, one area of a print was chosen such that the area corresponds to a "key area". ("Key area" refers to an area of the print which was supplied ink by a key.) The integrated density of that area was found from the sample copy. (Copy used in estimating unit i.e. Ektamatic "T" print), using the estimating unit. Using figure 15, the percent tint corresponding to that integrated density was found. For that specific key the proper curve was selected from figures 16 through 26. The key setting corresponding to the percent tint was found from the curve.

For example, the key setting for key number five on the third sample would be found in the following way:

(1) find the average integrated density for key five on sample three. (.22, Table 2).

(2) using Figure 15, find .22 on the Y-axis and move horizontally to the line, now move downward to the X-axis to find the percent tint. (44%)

(3) using Figure 19, find 44 percent on the X-axis and move vertically to the line of "best fit" and horizontally to the left for the key setting (12). If the setting was found to be in-between key settings, the nearest whole number was used. (The dials cannot be used more precisely than the nearest whole number). Table 4 shows the predicted and actual ink key setting.

Table 4 shows that even though all prints using the "educated guess" method were in spec, the key settings differ considerably from the predicted settings (Table 5). There were 110 key settings used in this test; of this 32.7 percent or 36 settings were identical to the predicted settings. Another 37.3 percent or 41 settings had readings within one increment of the predicted setting. Finally, the remaining 37 or 30.0 percent deviated two or more increments.

At this time it is not known how much tolerance a key setting has in delivering the correct amount of ink. Because of this, it is impossible to accept any settings as correct if it was not identical to the predicted setting.

Originally a statistical test using the difference of two means was going to be used to test if the "educated guess" method values and the predicted values came from the same population but, because of the large difference in key settings, it was clear there were two distinct populations present.

TABLE 5.

Predicted and Actual Key Settings

Key Number

#	2		3		4		5		6		7		8		9		10		11		12	
	*	-	*	-	*	-	*	-	*	-	*	-	*	-	*	-	*	-	*	-	*	-
1	-1	1	3	2	4	4	5	5	6	6	3	3	4	5	1	6	2	4	3	1	-1	1
2	-2	-2	0	1	1	2	2	2	4	3	2	2	1	1	1	1	10	3	9	2	0	-1
3	-1	0	10	6	11	7	12	8	8	8	7	6	8	8	9	8	9	5	9	4	1	1
4	-2	-2	-1	-1	0	2	5	4	6	5	7	4	2	4	2	3	2	1	1	1	-2	0
5	0	0	2	1	2	3	1	2	3	3	3	3	3	3	2	3	2	2	2	1	0	0
6	-1	-1	2	0	3	3	2	2	4	3	2	3	2	2	3	3	3	2	1	1	2	0
7	3	3	7	3	6	5	8	10	9	9	11	7	10	9	9	8	7	6	3	4	2	2
8	1	1	4	4	6	5	5	5	6	8	8	7	5	7	7	6	6	4	3	2	1	2
9	-2	-1	0	0	0	3	2	3	3	4	3	2	4	5	1	5	2	2	1	0	-2	-1
10	0	1	2	0	2	3	5	3	6	4	5	3	8	3	0	3	1	2	1	0	-2	0

* = Predicted Setting - = Actual Setting

Questions as to the accuracy of the predicted values arose. If pre-setting of the ink key was possible, still another test had to be performed.

In this test all ten forms were printed again. The ink fountain dials were set to zero as they were inked for each press run. With this being a test to determine whether or not predicted ink key settings were correct, once any ink key was set, it could not be adjusted to bring the print into spec. The ink and dampening dwell could be adjusted to either add or reduce water and ink. Before each press run the press was washed and ink added to the fountain. The dials were set to read as the predicted values indicated (Table 5). Table 6 shows the density values of each print. Of 110 pre-set key settings 108 or 98.2 percent were in spec. Because of the high percentage of correct pre-settings, it was trusted that a statistical test need not be performed to evaluate whether or not the test was successful.

In the case of sample two, the solid ink density patches for ink keys ten and eleven read in the area of the low 1.40's. If less ink or more dampening dwell was used to bring the two areas down into spec, it also lowered the other area out of spec on the low side.

A characteristic of sample number two was that in the area of key ten and eleven was a very large solid and on either side was large non-image areas. It is the author's opinion that this excess ink from ten and eleven was not

TABLE 6.

Printed Sample Densities Using Pre-Setting of Keys

Key Number

#	2		3		4		5		6		7		8		9		10		11		12	
	*	-	*	-	*	-	*	-	*	-	*	-	*	-	*	-	*	-	*	-	*	-
1	1.03		1.07		1.05		1.12		1.10		1.19		1.11		1.07		1.09		1.13		1.02	
2	-	off	1.12		1.19		1.17		1.15		1.18		1.17		1.14		1.13		1.14		-	off
3	1.20		1.16		1.15		1.07		1.07		1.11		1.00		1.00		1.11		1.18		1.20	
4	-	off	-	off	1.13		1.13		1.18		1.20		1.12		1.02		1.13		1.11		-	off
5	1.01		1.00		1.00		1.01		1.03		1.09		1.04		1.06		1.15		1.16		1.19	
6	1.07		1.09		1.02		1.02		1.04		1.07		1.03		.99		1.16		1.09		1.16	
7	1.12		1.14		1.07		1.10		1.13		1.15		1.08		.98		1.06		1.06		.99	
8	1.10		1.16		1.15		1.06		1.09		1.15		.98		.98		1.10		1.11		1.06	
9	1.15		1.13		1.19		1.13		1.15		1.16		1.09		1.08		1.13		1.20		1.15	
10	1.11		1.08		1.03		.97		.95		1.07		1.05		1.04		1.00		1.02		1.07	

* = Density of Printed Sheet Patch   - = Setting After Adjustment (if adjusted)

distributed to the adjacent area as in other cases. This problem of large solids flanked by large non-image areas could be a subject for future study to help refine the method.

Following the many adjustments of the ink and dampening dwell times, keys ten and eleven were adjusted to bring the print in spec. The predicted values of the keys were ten and nine respectively and the actual values were six and five. Even though the original settings were not correct, it did show that key ten needed more ink than key eleven.

With both the pre-setting and the "educated guess" method yielding in spec results with different key settings, it is the author's belief that there is a certain amount of latitude that a setting can have and still deliver the correct amount of ink to the plate. Also, there are a number of different ink key setting combinations that will also work for a given piece of copy. Referring to Table 5, sample ten; key number eight had much higher predicted setting than actual, which means that area should have been ink starved. Keys nine and ten had a higher actual setting than predicted which means that those areas should have had an excess of ink. It is believed that because of the vibrator roller some of the excess ink from key area nine and ten were transferred to key area eight. "...the vibrators tend to even out the supply of ink across the rollers."[1]

Because of the specifications allowing some tolerance, it was possible for key eight to be on the low side of spec and keys nine and ten on the high side of the tolerance.

Using sample ten, keys eight, nine and ten in Tables 4 and 6 something interesting happened. When the pre-setting was used, the density area key eight was higher than keys nine and ten. This is just the opposite from the "educated guess" method. This, of course, would be expected when comparing the actual and predicted values. This happens in a number of places throughout Table 5.

These two assumptions stated along with the variable of the dampening dwell could account for most of the variability between the actual and predicted settings.

FOOTNOTES FOR CHAPTER III

[1]Charles W. Latham, _Lithographic Offset Press Operating_, Graphic Arts Technical Foundation (1956) p. 30.

CHAPTER IV

CONCLUSIONS

The test involving the pre-setting of the ink keys before the press was started indicated that such a method is viable. The results indicate that over 98 percent of the key settings were correct.

It can be inferred by this test that with pre-setting of the ink keys, less makeready time would be required than with the conventional "educated guess" method.

Although the experiment did not work for all 110 possible pre-settings, it did however, give a very good approximation for the settings. In nine of ten samples all that had to be done to produce an acceptable print was to adjust the inking and dampening dwell times. By adjusting only these settings, it is believed that changes on the printed sheet will be seen more quickly than by adjusting all the ink keys in the fountain. When the ink keys are pre-set, further adjustments might be needed, but these adjustments are relatively small. Using the "educated guess" method, some key adjustments could be very large. In this case the press operator would spend more time and materials while waiting for changes on the press sheet.

If the pre-setting of the ink key was used in combination with an alcohol dampening system, the time to obtain ink-water balance would be substantially reduced and makeready time for an "O.K.ed" printed sheet would decrease.

Without dials on the ink keys it would be impossible for a press operator to know how much a particular ink key is open. This would cause, in many cases, either too much or too little ink reaching the plate, and large adjustments would be necessary which would again cause increased make-ready times, waiting for either ink to be added or removed from the inking system.

The dials also play an important part for the rerunning of jobs. If the dial settings were recorded after the end of each press run, it would help to further reduce makeready times for future runs. With no dials this is not possible.

In the study, perfect correlation did not exist between the predicted key settings and the final key settings (settings after actual key adjustment to obtain the best prints), found when using the "educated guess" method. This is a strong indication that there are some possible ways to set keys when the press is running for a given piece of copy because of the action of the vibrator (oscillating side-to-side) roller, since the roller can cause ink distribution laterally between neighboring keys.

The estimating unit appeared to have worked extremely well for estimating integrated densities of all types of copy. This scheme of one reading for each area of an ink key worked well.

CHAPTER V

RECOMMENDATIONS

To help further refine this method of pre-setting the ink distribution keys, some additional data from future studies would be needed.

Topics of possible studies might include:

(1) A method to pre-set the inking and dampening dwell times after the ink keys were pre-set. To do this, one must know how much ink would be discharged from the fountain with a variety of ink settings. An interaction between adjacent ink keys would also have to be known. Once this information is obtained, the possibility of determining the different dwell times and its affect on the amount of ink reaching the substrate can be researched.

(2) A study involving a method of pre-setting the amount of water being discharged from the fountain using a key system similar to the one used for ink. In this study a method to make the fountain solution more visous, possibly by adding a water soluble polymer, would have to be found.

(3) An interesting experiment would be to find how one ink key, either opening or closing, effects the amount of ink reaching the plate. This would have to be done using

different openings in different places across the fountain. There are many variations that could evolve in this experiment. A response variable could be the measuring of solid ink densities from the printed sheet, (dampening would effect results) or the monitoring of the ink film thickness across the form rollers.

(4) An investigation to find how many key setting variations are possible for a given piece of copy would be advantageous. This would involve extensive press time and much statistical work to find the various ink key settings and their effect on the printed sheet.

(5) A study to try to automate the estimating unit for the purpose of saving time and operator error. A scanning device with a phototube could scan the copy and store the integrated density for all points on the slit until the entire slit was read and then readings displayed or sent to a computer which has press calibration information stored to eliminate the using of line of "best fit" graphs to acquire ink pre-settings.

(6) In this study a model Chief 15 was used. If a larger press is used it is presumed that this would help control variation due to press characteristics.

(7) If a study of this kind was repeated, it would be interesting to see if there is a significant difference between a standard ink fountain and a segmented blade fountain.

GLOSSARY

Axis: An imaginary straight line which is perpendicular to the surfaces and joining centers of two or more surfaces of spherical lenses.

Cosine 4 Law: Illumination is brightest on the axis of a line and falls off towards the edges. The illumination falls off proportional to the fourth power of the cosine of the angle between a line joining that point to the lens and the axis.

Dwell Time: The amount of time the ductor roller is in contact with the fountain roller. This is a variable time when discharging either water or ink to the vibrator roller.

Educated Guess Method of Running Press: A method of setting the ink distribution keys by trial and error, or by experience of the pressman.

Fresnel Lens: A thin plastic or glass disc with concentric stepped rings with each step from the center ring, having curvature of a thicker lens. The combination of these concentric rings gives the same effect as a plano-convex lens. It is used with condenser lenses because of its short focal length and its ability to distribute image intensity over a large area.

Stepped rings for Fresnel lens

Dotted lines indicate plano-convex lens

Figure 27. Fresnel lens vs conventional lens

Integrated Density: The measure of average light from a subject or copy area.

Magnifying Lens: A lens with the function of increasing the size of a retinal image larger than an image formed with the naked eye.

Mechanical Vignetting: A fall off of illumination at the edges of an image produced by a series of lenses due to masking off of large angular rays at the edges of the lens mount.

Off-axis: When an object is not perpendicular to the surface of a lens.

On-axis: When an object is perpendicular to a surface of a lens and traveling through the lens center.

Parallax: A difference in reading when viewing a scale with a needle indication from two different points.

Real Image: An image produced when rays of light diverging from each point of a subject are brought to meet at a corresponding second point. These points can be focused on a screen for viewing.

Scale Reading: A value read on the estimating unit to indicate the integrated density of a piece of copy.

Starvation: An insufficient amount of ink on a given image which results in a print with low ink density.

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BIBLIOGRAPHY

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APPENDICES

APPENDIX A

SAMPLE ONE

THE FINAL NEGATIVE

For average lithographic requirements, there should be dots in all areas of the picture. Areas of the negative corresponding to the lightest tones (highlights) of the original should be almost solid black, with tiny clear dots. In the areas corresponding to the darkest tones (shadows) of the original, the negative should be almost clear film, with tiny black dots. All other tones of the picture will be represented by dot sizes between these two extremes.

- If the highlights are solid black, with no tiny clear dots, the main exposure was *too long.*
- If the clear dots in the highlights are too large, the main exposure was *too short.*
- If the highlights are satisfactory but the shadows are clear, with no dots, *more flash exposure* is needed.
- If the highlights are satisfactory but the shadow dots are too large, *less flash exposure* is needed.

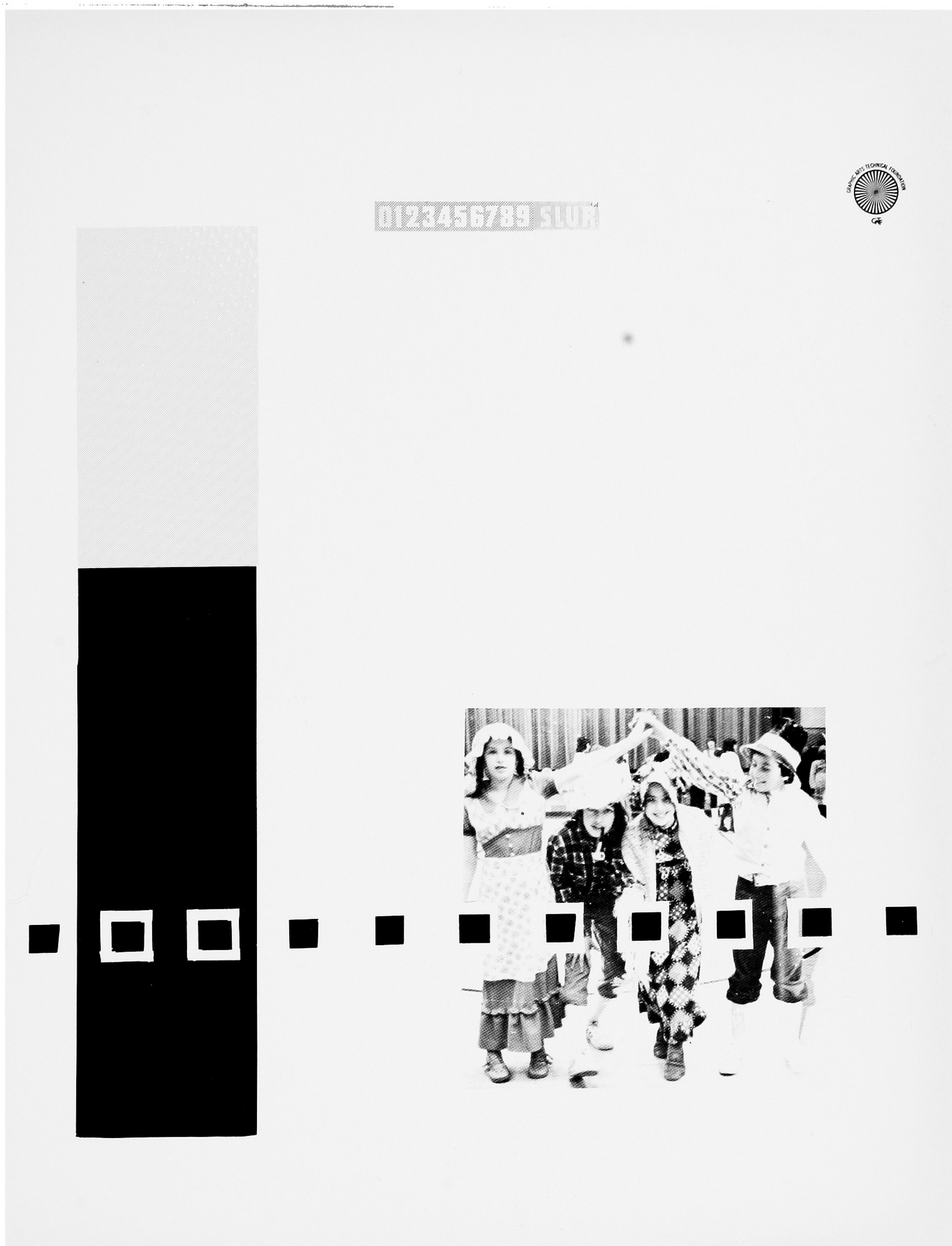
In modern photoengraving with powderless etching methods, the halftone negatives should have characteristics similar to those for lithography. For the older conventional plate-etching methods, the required characteristics are considerably different. Clear dots of much larger size are needed in the highlight areas of the negative.

NOTES ON THE PROPER CARE OF A CONTACT SCREEN

If most of your halftone work is of relatively small size (10 x 12 inches and smaller), and if you are occasionally required to shoot large halftones, you may be tempted to buy a large contact screen to use for all sizes. Remember this: contact screens are somewhat delicate—they are susceptible to scratches, they are affected by chemicals spilled on their surfaces, and they fingerprint just as a sheet of film would. They are relatively costly items—you would not wish to replace them weekly. Use a small screen for small-sized work, and a separate large screen for larger halftone work —and then PROTECT YOUR INVESTMENT.

1. Store it in its proper folder and box. Because all Kodak contact screens are made on ESTAR Base,

SAMPLE TWO



SAMPLE THREE

how to hit the jackpot on tv game shows

This fall, TV game shows are offering cash prizes large enough to pay next semester's tuition, tide you through a period of unemployment, or send you packing on a glorious vacation. Some are fairly begging for you to win them. "Most people seem to think that the studios are overrun with swarms of eminently qualified people who line up for months waiting to appear," says Ed Fishman, a TV contestant scout and author of *How To Strike It Rich on TV Game Shows.* "This is not the case."

Game shows fall roughly into two groups: those involving mainly luck, such as "Let's Make a Deal" or "Dealer's Choice," and those involving a skill, such as "Concentration" or "Jeopardy." Choose the kind of show you think you'd do best on. Bear in mind that in order to limit the number of times you may appear on one of their shows, all major TV networks eliminate the "professional contestant." (For example, ABC allows contestants to appear on only one show per year and no more than two in five years.)

Then, several weeks before you'd like to appear on a show, write to its "contestant coordinator." Addresses are usually given at the end of a show, or you can write directly to the network on which it appears. *Be brief,* including the basic facts about yourself; why you'd like to be a contestant; when you are available; and, if possible, a recent photo that needn't be returned. Some shows will offer you an interview on the basis of a letter; others will request that you attend a taping and sign up there.

During an interview, remember that all shows look for contestants with lively personalities. Dress attractively, but not flashily. Ed Fishman points out that most shows are looking for the species he calls "Americana Domesticus"—not, say, the female Alice Cooper.

"The best contestant is one whom you'd really enjoy having in your home," says Jim McCrell, host of "Celebrity Sweepstakes." "We look for a naturalness and ability to play the game without getting uptight about it."

The more complex skill games have other requirements, too. "For our shows, you need to be outgoing—to have what we call pizzazz," says Edythe Chan, who works for Bob Stewart Productions as associate producer of "Jackpot!" and contestant coordinator of "The $25,000 Pyramid." "You also need a good general knowledge of the facts everyone learns in school. You should know, for example, that Marie Antoinette said, 'Let them eat cake.' You should also know that Pierre Trudeau is the prime minister of Canada and that Ohio is 'the Buckeye State.' In other words, since our shows involve questions and answers, you should be up on what's going on in the world." ("Jackpot!" includes a written general-knowledge test as part of its screening procedure.) Adds Terri Kestenbaum, a 25-year-old copywriter who recently won $5,047.50 on "Jackpot!": "Above all, you need to be able to think on your feet."

For most contestants, the secret of winning seems to be: "Relax." All top winners eventually have to keep cool in the clutch, so one clue to how well you'd do on a quiz show is how well you do just that.

A final word of encouragement: If you can't or don't want to appear on a show, some, such as "Concentration," have "home audience participation" that allows you to play simply by sending in a postcard. And, if you do get on, the sky—or maybe just a sexy new MG—is the limit.

SAMPLE FOUR

We'll take almost anybody!

Even though you're a wise, unworthy, unbelieveable college drop-out, we'll still take you. Why? Not because we feel sorry for you, but because we need the help. So remember; when you're out--you're in with . . .

GENERAL ECCENTRIC

SAMPLE FIVE

Ezra Hale cited by Nathaniel Rochester Society for "outstanding service" to the Institute

In recognition of his numerous contributions to the advancement of RIT, Ezra A. Hale, 61 Douglas Road, Rochester, will receive the Nathaniel Rochester Society (NRS) Award for 1976.

Walter A. Fallon, NRS chairman and president of Eastman Kodak Co., and Dr. Paul A. Miller, RIT president, presented the award at the Society's annual awards dinner January 27 at the RIT campus.

The award, established in 1972, honors outstanding service to the Institute and is the highest tribute presented by the Society. Hale is a charter member of the Society.

Hale, honorary vice chairman of the Board and former chairman of the Board of Lawyers Co-operative Publishing Co., Inc., was elected to the RIT Board of Trustees in 1935 and recently completed his 40th year of service to the Institute.

Hale has held membership in several of the committees of the Board, including the Executive committee and the Finance committee, which he chaired from 1950 to 1954. He played a leadership role in the decision to build the new campus in Henrietta.

He was named to its Steering committee and served as chairman of the Funds committee. Under his leadership the Funds committee supervised the New Campus Fund Campaign by raising more than $19 million against a goal of $16.8 million.

His family has had an unbroken record of service to the Institute for 90 years. In 1885, Hale's grandfather, Ezra R. Andrews, was one of the founders of Mechanics Institute and served on the Board for 15 years. His grandmother served as trustee for nine years.

Mrs. William B. Hale, Hale's mother, was elected to the Board in 1896 and served for 37 years. His father served on the Board from 1910 until 1938.

Prior recipients of the award have been Gaylord C. Whitaker in 1973, Trustees of the Mary Flagler Cary Charitable Trust -- Edward S. Bently, Herbert J. Jacobi, Helen Lee Stanton, Frank S. Stubbs -- in 1974, and Mr. & Mrs. Brackett H. Clark in 1975.

Founded on October 29, 1967, the Nathaniel Rochester Society, named in honor of the founder of our city who was the first President of the Institute in 1829, recognizes the importance of a close relationship between the leaders of the community and Rochester Institute of Technology.

The Society is sponsored by the Institute's Board of Trustees, and its members represent a major resource of leadership and financial support.

2. Unterbrecherbad: KODAK Indikator Stoppbad oder KODAK Stoppbad SB-1a ca. 10 Sekunden bei 18–21°C und ständiger Bewegung.

3. Fixieren: KODAK Fixierbad oder KODAK Fixierbad F-5—2 bis 4 Minuten **oder** KODAK Rapid Fixer—1 bis 2 Minuten bei 18–21°C und ständiger Bewegung.

4. Wässern: ca. 10 Minuten in fließendem Wasser bei 18–21°C. Um Trockenspuren zu vermeiden, wird der Film nach dem Wässern in KODAK PHOTO-FLO Lösung getaucht, oder das Wasser wird sorgfältig mit einem Fensterleder, einem weichen, nassen Viskoseschwamm, oder einem weichen Gummiquetscher (z.B. Autoscheibenwischer) entfernt.

5. Trocknen.

Abschwächung und Punktätzung: Um Strichnegative zu klären, verwendet man KODAK Abschwächer R-14*, der keinen Gelbkranz hinterläßt oder KODAK Farmer'scher Abschwächer R-4a*. Zur Punktätzung wird der KODAK Abschwächer R-14* empfohlen.

*Rezept: Siehe Broschüre "*Sensitometrie, Rezepte, Arbeitsanleitungen*", erhältlich von Kodak.

Mechanische Filmentwicklung: Nähere Angaben erhalten Sie auf Anfrage von der Kodak Niederlassung in Ihrem Land.

Hinweis: Sollte sich herausstellen, daß dieser Film fehlerhaft hergestellt, beschriftet oder verpackt worden ist, so wird dieser Film durch einen unbelichteten ersetzt. Ausgeschlossen sind alle weitergehenden, ausdrücklichen oder stillschweigenden Gewährleistungspflichten und alle weitergehenden Ansprüche, insbesondere Schadenersatzansprüche einschließlich aus positiver Vertragsverletzung.

Kodak, Kodalith, Estar, Wratten und Photo-Flo sind Warenzeichen.

— ESP —

[redacted] elícul: [redacted] mática [redacted] ımo cc [redacted] • Cua [redacted] ‹pone [redacted] de la [redacted]
: proc tivos ; later para l e fotc • El soporte ESTAR de 0,10 mm. proporciona excelente estabilidad dimensional • Seca rápidamente y posee una superficie de emulsión que reduce al mínimo los anillos de Newton.

Luz de Seguridad: Use una lámpara de seguridad con un Filtro KODAK de Seguridad No. 1A (rojo pálido) y una bombilla de 15 vatios, situada a no menos de 1,2 metros del plano de exposición.

EXPOSICION • **Advertencia:** Para evitar puntitos y manchas cerciórese de que la película y el vidrio del tablero de copia se encuentren limpios y libres de polvo.

Ajustes de Exposímetro: Para exposición a través de la base. Cuando se expone por el lado de la emulsión, doble estos ajustes de exposímetro o reduzca a la mitad la exposición calculada.

3

SABanquet1976

We enter into love....
as purely and happily
as the song of birds
into the hush
of daybreak.
This is
the morning of our love.

SAMPLE SIX

For most of the 38 years since the explosion of the German zeppelin Hindenburg marked a fiery end to the airship era, proponents of lighter-than-air craft have been regarded as incurably romantic, if not suicidal. No longer. Now aeronautical companies and government agencies in Europe and the United States are plowing money and expertise into designs and prototypes of giant dirigibles that may soon ship cargoes too cumbersome for normal transport methods, carry passengers far more cheaply than conventional aircraft and even engage in military surveillance.

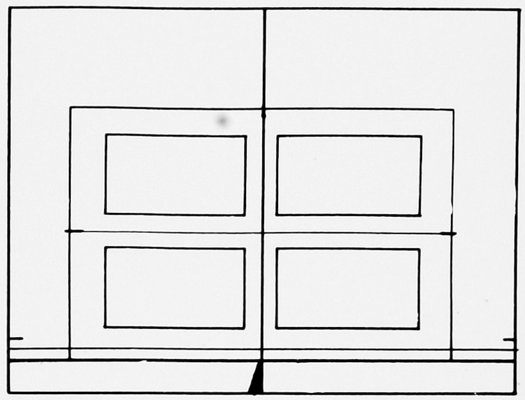
At a Royal Airforce station in Britian last May, a 30-footwide, helium-filled craft, shaped like a flying saucer rose into the air, hovered and flew lazily around a large hanger. The craft, called the Skyship, is the prototype of a 720-foot monster that the developers expect to have in commercial operation within three years. Last year French engineers carried out wind-tunnel tests on a 25-foot model of a similarly shaped airship named the Titan. And Shell Oil Co. has spent over $1 million studying the potential of lighter-than-air tankers to carry natural gas.

In the U.S., the Air Forcs is investigating the use of dirigibles to ferry Minuteman missles from silo to silo, the Navy is sponsoring studies of airships' ability to track submarines and Combustion Engineering, Inc., a builder of nuclear-reactor components, is looking into the use of lighter-than-air craft to haul its mammoth products to reactor sites. "Airships deserve a second look," said Sen. Barry Goldwater in a recent speech.

THE LAYOUT

Each item on the layout is necessary. Be sure that you clearly understand what each part is used for and who uses it.

Directions: On this proof you have made, label the parts of the layout with their appropriate names. Find the goldenrod, press sheet, clamp margin, gripper margin, vertical and horizontal centerline, register marks, cylinder marks, and centerline triangle.

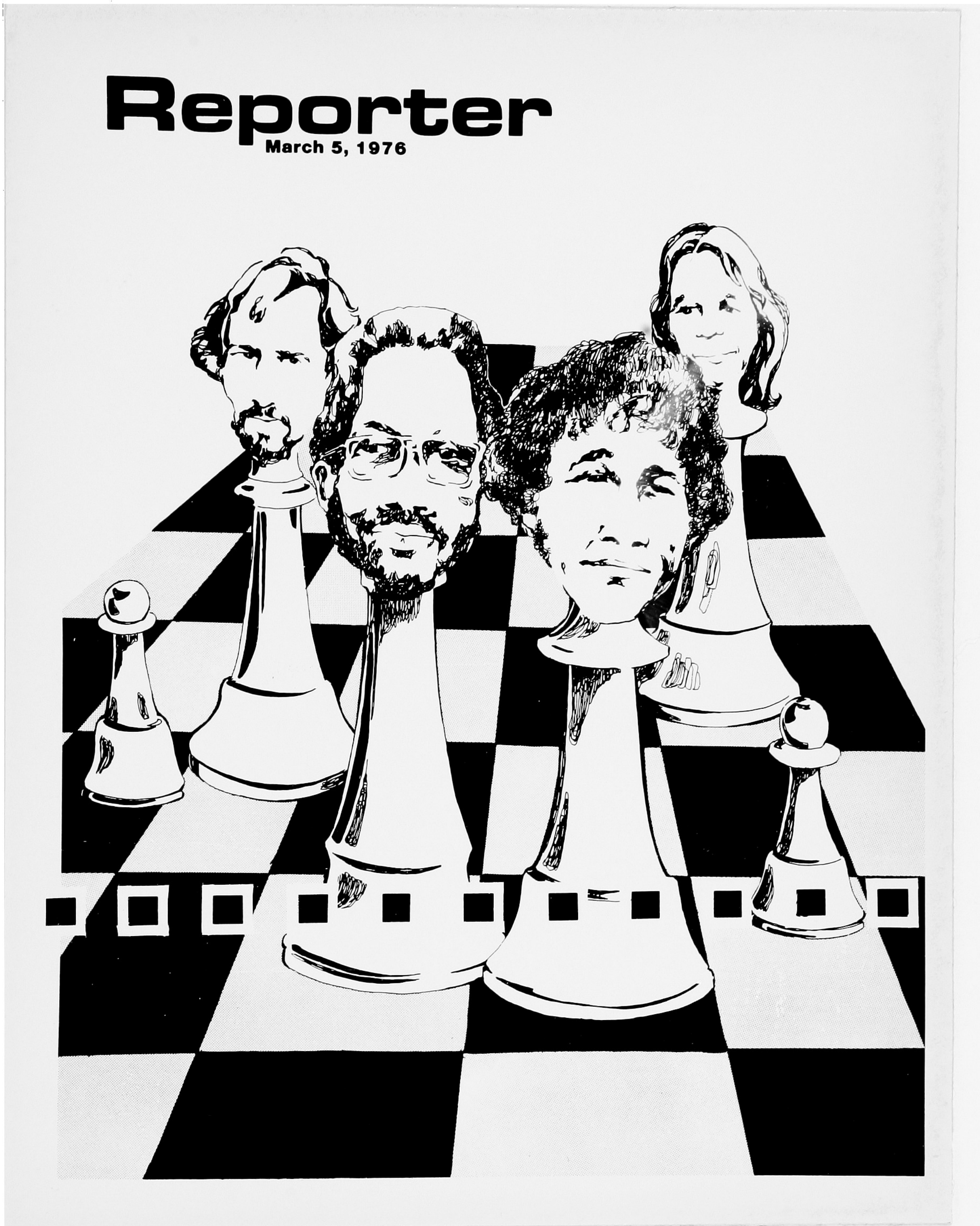


The clamp margin line and the lead edge of the press sheet are one in the same on the flat. The gripper margin is located on the press near the lead edge. The gripper margin indicates the area in which there is to be no image area on the press sheet. This is the area where the press grippers will take hold of the sheet to pull it through the press.

Trim areas, trim lines and trim marks are not shown on this layout. The text shows their proper use. They are used on many flats.

SAMPLE SEVEN

SAMPLE EIGHT



SAMPLE NINE

ABCDEFGHIJKLMNOPQRSTUVWXYZFGHIJKL[redacted]"NOPQRS

abcdefghijklmnopqrstuvwxyz abcdefghijklmnop[redacted]qrstuvwxyz

new books

1888 Electrotype Specimens Reveal Aspects of Period Life

ELECTROTYPE SPECIMENS 1888, by James Conner's Sons. A facsimile edition by Morgan & Morgan, Inc., with a new introduction by Paul Hayden Duensing. $17.50. During the 1860s and '70s, the almost incredible variety of printer's electrotypes sold by James Conner's Sons presented in fascinating detail the scenes, interests, and aspirations of everyday life in that period.

The Conner Foundry was one of the largest and most influential in the country during those two decades and it was one of the major sources of "printer's cuts." For the smalltown newspaper and job printer far removed from the custom engravers of the cities, the illustrations contained in this volume were virtually the only means of relieving the monotony of the type page.

Practical Guide for Supervisory Training and Development

PRACTICAL GUIDE FOR SUPERVISORY TRAINING AND DEVELOPMENT, by Donald L. Kirkpatrick. $9. This book takes a pragmatic look at supervisory training and offers case histories showing how supervisory programs and concepts of supervisory training are implemented.

It is one of the few books of its kind to emphasize the "how" as well as the "why" of supervisory training and development. It is written to give practical help to line managers and personnel and training directors of small and large organizations.

Special Combination Offer On Two 1972 Clip Art Books

SEASONS AND HOLIDAYS CLIP ART BOOK and EVERYDAY CLIP ART BOOK, published by Valdes Associates, Inc., Westbury, N.Y. 11590. Order direct from publisher.
$?0.50 f[illegible] books [illegible] sheet
[redacted] and l [redacted] ink c [redacted] major [redacted]
ys and [redacted] e sea [redacted] every
k cu 40 n 11
inch sheets

Illustrations are clean line art, 65-screen tone, or combinations of both in various sizes for immediate reproduction. Both books are indexed and cross-indexed and each is bound with screw posts for easy removal and replacement of sheets

ONE LINE MANUAL OF STYLES, issued by Photo-Lettering, Inc. $10 for paperback edition. This book is a one-line showing of Photo-Lettering's alphabets, as well as a compact alphabet sourcebook for the graphic designer or browsing typophile. All styles are indexed by name and artist and the volume has a visual listing of the general categories into which the many type styles have been classified.

BIOGRAPHY AND TYPOGRAPHY OF WILLIAM CAXTON, by William Blades, introduction by James Moran. $13.50. "William Blade's published researches on William Caxton represent a landmark in biographical history," Mr. Moran writes," and, although more than 100 years have passed since publication, they have not been superseded as a record of Caxton's life and achievements."

UP YOUR OWN ORGANIZATION: A Handbook for the Employed, the Unemployed, and the Self-Employed on How to Start and Finance a New Business, by Donald M. Dible. $24.95. This book was written as a complete handbook for those among the skilled-but-unemployed who want to go into business for themselves and as a convenient guide for those who already have a business of their own and who would like to secure additional capital. The book includes an introduction by Robert Townsend of *Up the Organization* fame.

GRAPHIC GRAFLEX PHOTOGRAPHY, by Willard D. Morgan and Henry M. Lester, facsimile edition. $15. This well-known photography manual was first published in 1940 and was continually revised and updated for 18 years thereafter. It contains both elementary and advanced information, applicable to all levels of photography, for use both with and without the Graflex or Graphic cameras.

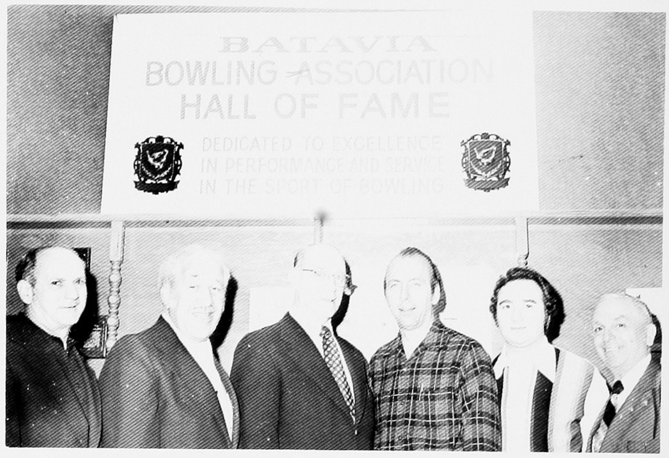
PROFESSIONAL MAIL SURVEYS, by Paul L. Erdos. $17.50. "In the simplest possible language," the flyleaf reads, "*Professional Mail Surveys* sets forth tested procedures for designing surveys, selecting mailing lists, composing questionnaires, processing data, and presenting the results—all within the allotted time and budget."

LESLY [redacted] C RE [redacted] HAN [redacted]
edited [redacted] p Les [redacted] 5. Abo
of th [redacted] l in [redacted] essor
Lesly's earlier handbook is new or revised. The 557-page, oversized book contains 53 chapters by 41 authorities covering all aspects of the public relations field.

SAMPLE TEN

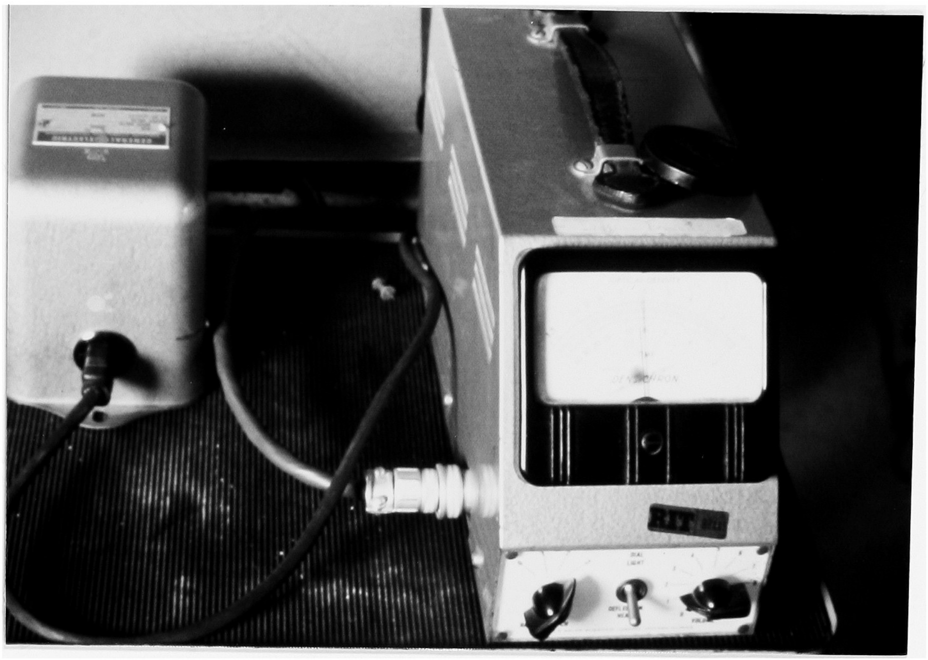
ACT
NOW!
RUSH!

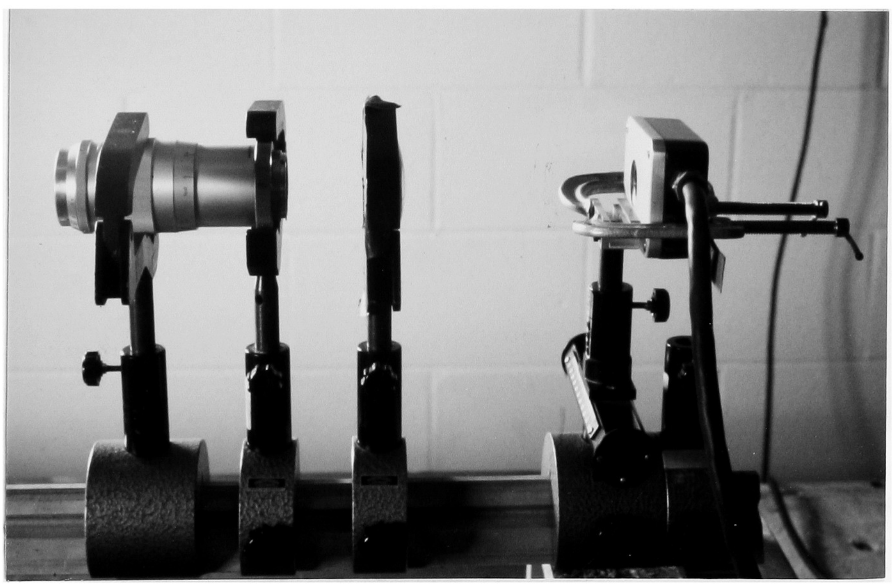
Top prices paid for gold coins and articles regardless of age. Old gold at a premium. Dealer inquiries invited. We will not be overbid! Come see us first. Coins and stamps of every description on our premises.



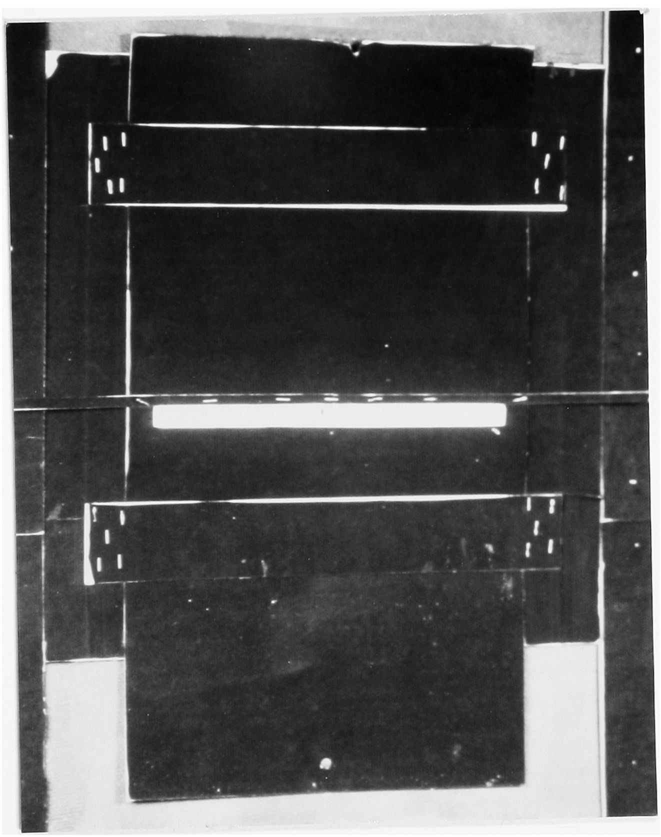
M

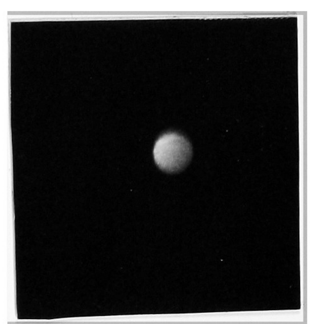
APPENDIX B


RIT



Photographic mask in front of field lens





Lightbeam reaching phototube

Mask on copyboard