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ABSTRACT

A hand-operated mechanical device, called an X-Y Platform because of its ability to undergo orthogonal planar motions reminiscent of X and Y coordinates, permits design simplifications and lower costs when used with RANDSIGHT-type closed circuit television to enable the partially sighted to read and write. This paper presents a detailed discussion of the construction of the platform together with recommendations for its operation and use for both reading and writing. Features believed necessary for a high quality platform are summarized at the end. (Author/SH)

R-831-HEW/RC
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An X-Y Platform for Randsight-Type Instruments

R. W. Clewett, S. M. Genensky and H. E. Peterson

A Report prepared under a Grant from

DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE

Rand
SANTA MONICA, CA. 90406

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PREFACE

This is one of a series of reports on RANDSIGHT research. That research is aimed at designing, fabricating, and testing equipment which will assist the partially sighted. This Report describes a hand-operated mechanical device which when used in conjunction with a closed circuit TV system permits the partially sighted to read printed and handwritten material and to write with a pen or pencil. This device, which we have chosen to call an X-Y Platform, has been in continuous operation since December 1970, and has been used successfully by more than 50 legally blind, partially sighted people. Its favorable acceptance by them has persuaded us to retire the servomechanism that governed camera rotation about a horizontal axis in our closed circuit TV system, RANDSIGHT I. As before, the camera points downward, but now it is held fixed; it views printed or handwritten material located on the upper face of the X-Y Platform's working surface while the latter is moved to the left or right to traverse a line, or forward or backward to shift from line-to-line.

The ease of operation, simplicity of design, and possibility of both simplifying the overall design and lowering the cost of closed circuit TV systems without sacrificing instrument quality or effectiveness have made X-Y Platforms attractive to persons or companies interested in building closed circuit TV systems for the partially sighted.

The research described in this Report was supported jointly by the Social and Rehabilitation Service of the Department of Health, Education, and Welfare under grant number 14-P-55285/9-01 and by The Rand Corporation with its own corporate funds.

SUMMARY

A hand-operated mechanical device called an X-Y Platform is described which, when used with RANDSIGHT-type closed circuit TV systems for the partially sighted, permits design simplifications that lead to lower costs without sacrificing instrument quality or effectiveness.

A detailed discussion of the construction of the platform together with recommendations for its operation should be of value to those who would like to construct their own X-Y Platform.

Care has been taken to describe in detail how the platform is used for both reading and writing. In addition, a summary of features we believe should be incorporated in a high-quality platform is included.

ACKNOWLEDGMENTS

The authors are indebted to G. W. Dietrich and O. Garza for the fabrication of our X-Y Platform. The quality of its construction is due in large measure to their competence.

The authors are also indebted to M. R. Davis for his support and interest and to J. Beavers for the quality photographs in this Report.

CONTENTS

I. INTRODUCTION

This Report describes a hand-operated mechanical device designed by R. W. Clewett and fabricated in the Rand model shop. It has proven very successful in conjunction with RANDSIGHT-type closed circuit TV systems for the partially sighted. This device is placed on a desk or table below the TV camera. Reading or writing materials are placed on its upper surface which may be easily moved left or right to traverse a line of print or handwriting and toward or away from the user to shift from line to line. The ability of the upper surface of the device to undergo these orthogonal planar motions reminded us of the x and y coordinates used in plane analytic geometry, and so we decided to call this instrument an X-Y Platform.

The simplicity of this device, its ease of operation, and the simplification in overall instrument design that results from its incorporation in RANDSIGHT-type instruments have made and should continue to make it attractive to manufacturers who are interested in producing lower cost, closed circuit TV systems for the partially sighted without sacrificing instrument quality or effectiveness.

II. DESCRIPTION OF THE X-Y PLATFORM*

The X-Y Platform currently in use with RANDSIGHT I** may be thought of as consisting of four relatively thin layers. The bottom layer is made up of a 12 x 14-inch rectangular aluminum base plate (1) 3/16 inches thick to which is cemented a 1/8-inch rubber pad (2) of the same dimensions. The rubber pad prevents the X-Y Platform from slipping on a smooth desk or table and reduces the possibility of scratching or otherwise damaging the supporting surface. The second layer consists of a pair of Jonathan

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*Throughout this Report the names of various parts of the X-Y Platform will be followed by numbers enclosed in parentheses (see page 3). The numbers in parentheses also appear in conjunction with Figures 1, 2, and 3. There they indicate where the part being discussed is located in the overall design of the platform.

**The history, development, and experience with RANDSIGHT I are given in the following references:

P. Baran, S. M. Genensky, H. L. Moshin, and H. Steingold, A Closed Circuit TV System for the Visually Handicapped, The Rand Corporation, RM-5672-RC, August 1968 (Also published in Research Bulletin of the American Foundation for the Blind, No. 19, June 1969, pp. 191-204).

S. M. Genensky, Some Comments on a Closed Circuit TV System for the Visually Handicapped, The Rand Corporation, P-3984, December 1968 (Also published in American Journal of Optometry and Archives of American Academy of Optometry, Vol. 46, No. 7, July 1969, pp. 519-524).

S. M. Genensky, H. L. Moshin, H. Steingold, A Closed Circuit TV System for the Visually Handicapped and Prospects for Future Research, The Rand Corporation, P-4147, July 1969 (Also published in Annals of Ophthalmology, Vol. 2, No. 3, June 1970, pp. 303-308).

S. M. Genensky, Closed Circuit TV and the Education of the Partially Sighted, The Rand Corporation, P-4343, March 1970 (Also published in Educational Technology, Vol. 10, No. 8, pp. 27-31).

LIST OF PARTS OF THE X-Y PLATFORM SHOWN
IN FIGURES 1, 2, AND 3

(1) Base plate

(2) Rubber pad

(3) Inner member of drawer slide (second layer)

(4) Stop block (second layer)

(5) Outer member of drawer slide (second layer)

(6) Working surface

(7) Inner members of drawer slide (third layer)

(8) Stop block (third layer)

(9) Outer member of drawer slide (third layer)

(10) Adjusting rod

(11) Pillow block

(12) Anchor block

(13) Knob

(14) Spring bar

(15) Spring

(16) Lever bar

(17) Pivot stud

(18) Brake shoe

(19) Brake rail

(20) Steel balls

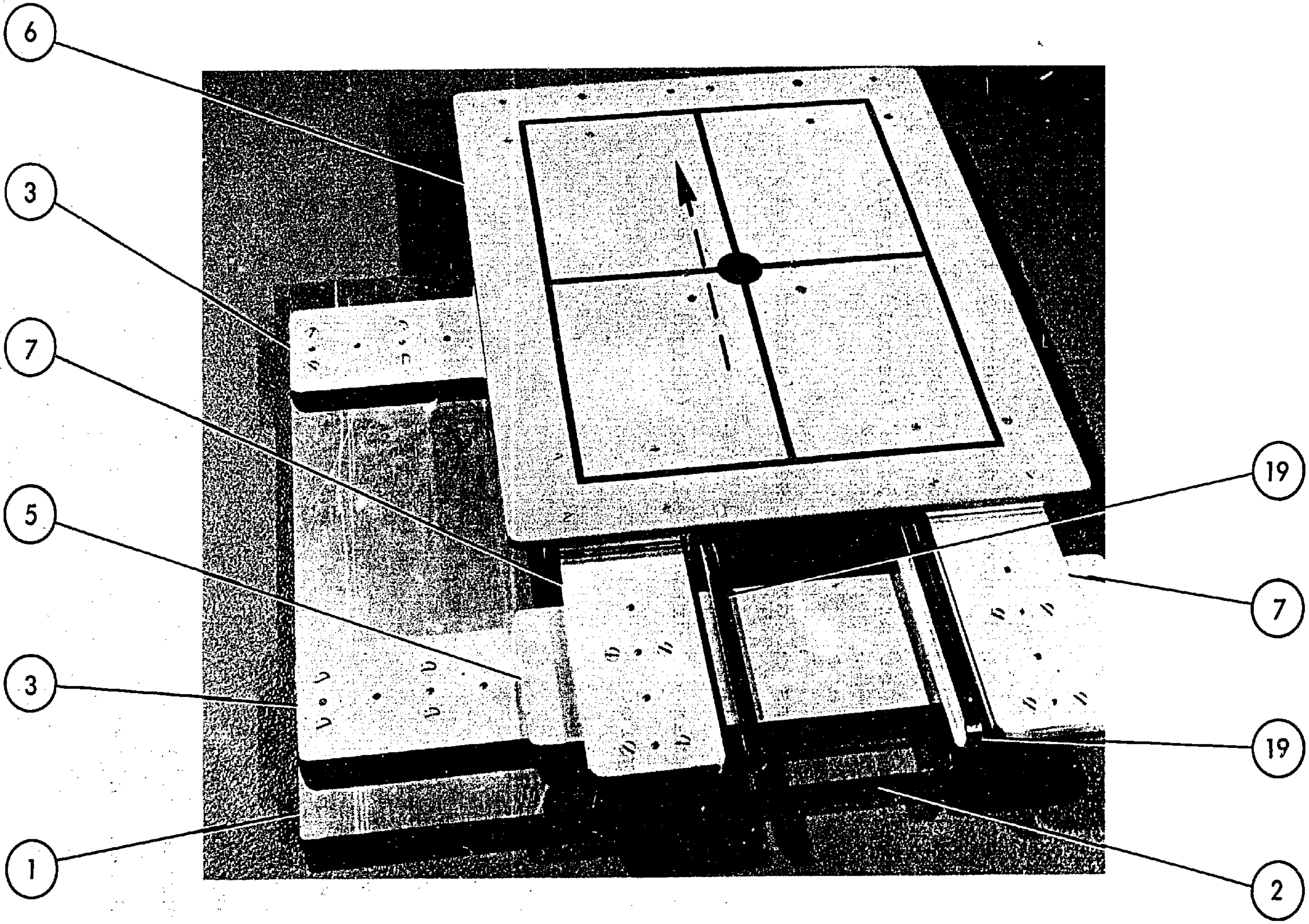

Fig. 1—Top view of X-Y Platform showing its working surface displaced to the right and to the rear

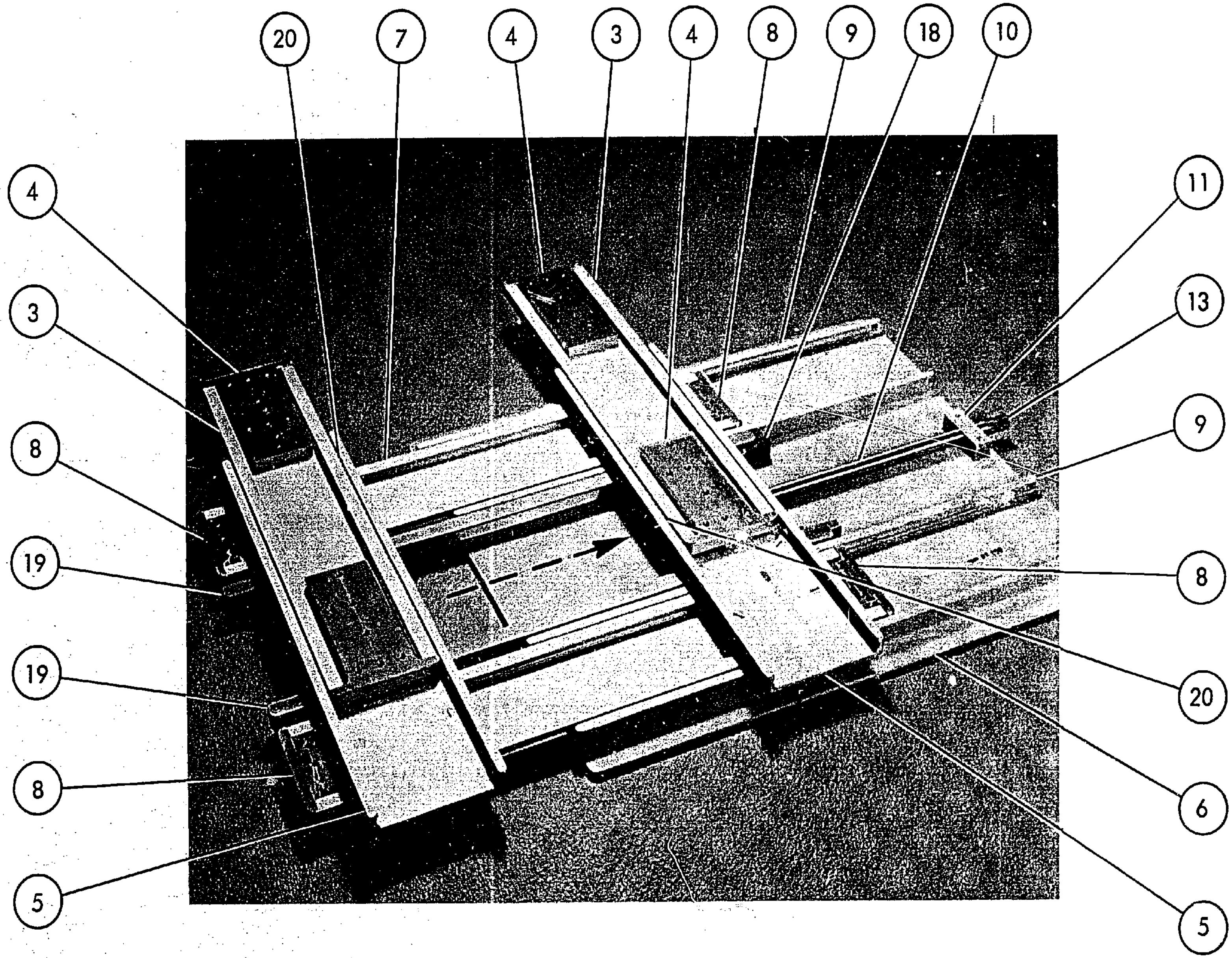

Fig. 2—X-Y Platform lying on its working surface. The base plate has been removed to reveal details of drawer slide construction.

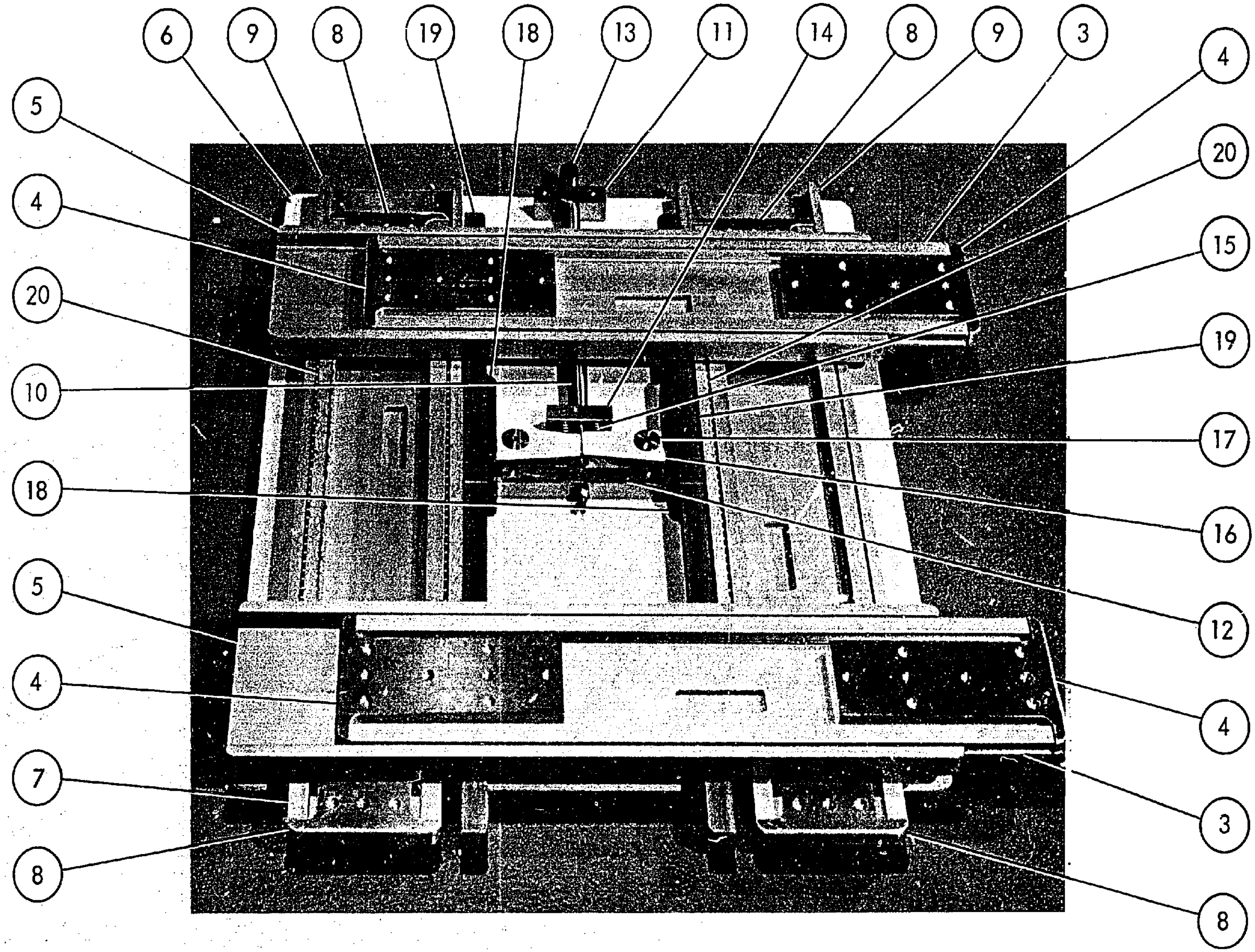

Fig.3—X-Y Platform lying on its working surface. The base plate has been removed to show details of braking system and drawer slide construction.

145 QD "Thinline" aluminum drawer slides.* The inner members (3) of these slides are held in place by screws which attach them and the stop blocks (4) to the aluminum base plate (1). Each of the members of this pair of slides is 12 inches long, and the stop blocks (4) are positioned to permit the outer members (5) to move through a distance of 8 3/4 inches. This pair of drawer slides governs the left-to-right and right-to-left motions of the X-Y Platform's working surface (6). The third layer consists of another pair of drawer slides placed at right angles to the slides in the second layer. The inner members (7) of these slides are held in place by screws which pass through their stop blocks (8) and terminate in the outer members (5) of the slides in the second layer of the platform. Each of the slides in the third layer is 14 inches long, and its stop blocks (8) allow its outer member (9) to traverse a distance of 11 3/4 inches. These slides control the line-to-line motion of the X-Y Platform's working surface (6). The fourth and topmost layer of the platform is the working surface (6) which consists of a 12 x 14-inch rectangular sheet of masonite 1/8 inch thick. It is held in place by screws which fasten it to the outer members (9) of the slides in the X-Y Platform's third layer.**

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*Jonathan Manufacturing Company, Fullerton, California.

**Recently we built a second X-Y Platform. Magnets may be used to hold one or more sheets of paper flat and in place on the upper face of its working surface, because that

Our experience has shown that it is advisable to provide a means of imposing a variable source of frictional loading on the drawer slides that govern the line-to-line motion of the X-Y Platform's working surface. When this is done, even if the TV camera is transmitting a highly magnified image, it is possible for young and old alike to easily guide the platform's working surface (6) so that the image of a portion of a line of print remains horizontal and does not drift up or down on the TV monitor as the working surface is moved to the left or right.

The friction mechanism of the X-Y Platform is shown in Fig. 3. The adjusting rod (10) is supported by the pillow block (11) and the anchor block (12). These blocks are screwed onto the bottom side of the working surface (6) and move with it. As the knob (13) of the adjusting rod (10) is turned and the rod screws into the anchor block (12), it carries the spring bar (14) forward compressing the springs (15) against the ends of the lever bars (16). This spring force is directed by the lever bars (16) and pivot studs (17) to the brake shoes, forcing them against the brake rails (19). As the spring and brake shoe assembly is moving with the working surface (6), and the brake rails (19) are

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surface consists of two layers, a 12 x 14-inch sheet of masonite 1/8 inch thick topped by a 3/64-inch sheet of steel of the same dimensions. The masonite is bonded to the steel by contact cement. Although we have been using this platform for a very short while, we have found this magnetic working surface to be very useful for both reading and writing.

fixed, this results in the desired friction during the line-to-line motion of the platform. The relatively large contact area of the brake shoes (18) and the low spring constant give a smooth even drag that can be increased by turning the knob (13).

There are many simpler ways of building a friction mechanism. However, the system we used was chosen for several reasons: It permits the frictional loading to be adjusted while the platform is in the operating position. It places the knob (13) in the same location relative to the working surface (6) through the entire range of platform motions. It applies the frictional loading symetrically and to structural members such as the brake rails (19), but not to drawer slide members.

All the exposed edges of the X-Y Platform have been rounded and smoothed to prevent a user from being cut or scratched while handling the device. Care has also been taken to design the platform to minimize the possibility of a user injuring a finger as the working surface is moved across a line or from line-to-line. We have had no accidents resulting from the use of the platform, and it has been in daily use for at least 6 months by persons of all ages with a wide variety of ocular disorders.

Our decision to use the 145 QD "Thinline" drawer slides was based on our recognition that they would be able to support very heavy loads (for example, an unabridged dictionary) and yet move smoothly and easily. They are able to do this because they are made of heavy-gauge aluminum and involve the use of hundreds of precision-made steel balls (20) which are arrayed in horizontal rows between the inner and outer member of each drawer slide.*

Some modification was necessary in the design of the drawer slides before they were suitable for use in the X-Y Platform. Most commercially available drawer slides constrain their outer members to move back and forth between a closed configuration and to an extended position to one side of the closed configuration. To permit the outer members to move an equal and specified distance in either direction from the central closed position, it was necessary to design and fabricate new stop blocks, disassemble the ball-bearing track, press additional stop pins into the outer members and mill stop-block seats into the ends of the inner members. After locating and drilling the holes for the mounting screws, the ball-bearing track and stop blocks were reassembled ready for mounting. Considerable care had to be taken in locating the mounting holes in all parts because errors in positioning them led to misalignment of the slide pairs, which

*Normally these drawer slides are used to support heavy electronic equipment that is set in racks or drawers in a metal frame or cabinet. When used for this purpose, the outer members of the drawer slides are fastened to the supporting frame or cabinet; the inner members are attached to the lateral sides of the racks or drawers.

caused the working surface to undergo sticky or erratic motions.*

Although there is considerable latitude in selecting the color of the upper face of the working surface (6), care should be taken to choose a pleasing neutral color with a gray equivalent on the TV monitor that will enable the user to clearly distinguish the margins of reading and writing materials from the exposed portions of the upper face of the working surface (6), regardless of whether he is viewing an image which presents the gray scale in normal or reverse order. It is also advisable to choose a low-reflectivity finish which will not cause excessive glare when viewed directly or on the TV monitor.

When closed, both of our X-Y Platforms are 14 inches long, 12 inches wide, and about 1 3/8 inches high. One of them weighs 14 pounds and its moving parts weigh 8 1/4 pounds; the other one weighs 11 1/4 pounds and its moving parts weigh 6 pounds. Most of the difference in the mass and the distribution of the mass of these two platforms is due to the fact that the working surface of the former contains a 3/64-inch steel plate; the working surface of the latter does not. The small height and the mass and

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*Drawer slides are available in a variety of sizes and styles. The selection is largely a function of availability and ease of adaptability to the contemplated design and cost. However, it is imperative that the selected drawer slides provide smooth easy motions under the anticipated loading. A slide that deforms appreciably under the expected loading would probably cause the working surface to undergo rough and erratic motions.

distribution of mass of these platforms appear to be desirable features. The thin construction permits a user to sit at a normal table or desk, move the platform's working surface (6), and manipulate reading and writing material on that surface with his hands, wrists, or arms located in natural and comfortable positions. The mass or weight of the platform and its distribution allow the user to maintain full control of the motion of the working surface (6). Genensky reports that these features, coupled with ample friction applied to the drawer slides governing the line-to-line motion of the working surface (6), permit him to work comfortably and naturally with the platform for hours at a time. At times he is not even conscious of the presence of the platform or that he is manipulating it while reading or writing. We must confess that we were surprised that the partially sighted preferred to work with a fairly massive X-Y Platform rather than with a light one.

Recent investigations have indicated that the working surface of our X-Y Platform may not be large enough to accommodate all of the reading matter that is commonly used with it. Genensky reports that some of that reading matter (for example, some technical journals with flexible covers) hang over the edge of the working surface (6) and drag on the desk when he is manipulating the working surface. Although it is not necessary for the surface to support every square inch of the material placed on it, it appears to be desirable to design the surface so that it will be large enough to accommodate most of the reading and writing materials placed on it without having those materials touch the desk or table. However, it is very likely that here a compromise may have to be made, because it would not be advisable to construct a working surface that was so much larger than the base plate that the X-Y Platform tended to tip from side to side as the working surface was manipulated, nor would it be prudent to make the platform's planar dimensions so big that its working surface required an excessively large area in which to maneuver.

Figure 1 shows the fully assembled X-Y Platform extended to the right and to the rear. The broken arrow indicates the front-to-back axis of the platform and the arrowhead points toward the rear of the platform.

Figure 2 shows the X-Y Platform lying on its working surface (6). The base plate (1) has been removed so that details of the drawer slide construction may be seen. The drawer slides governing motion toward the left and right are shown where they would be located if the platform were right side up and its working surface (6) were extended to the right. Similarly, the drawer slides governing the line-to-line motion of the platform are shown where they would be located if the platform were right side up and the working surface (6) were extended to the rear. The broken arrow is parallel to the center line of the working surface (6) that runs from the front to the rear of the platform. The arrow points in the direction of the rear of the platform.

Figure 3 also shows the X-Y Platform lying on its working surface (6), with its base plate removed. Details of the drawer slide construction are visible as are details of the braking mechanism. The front to rear axis of the platform runs from the bottom to the top of the figure.

III. READING AND WRITING WITH THE X-Y PLATFORM

If the user has not worked with the X-Y Platform before or if other people have used it since he last worked with it, he may wish to adjust the friction of the line-to-line motion of the working surface (6). After this is done, the user moves the working surface toward and away from himself several times to obtain a "feel" for the change in the friction. If he is not satisfied with the resulting line-to-line motion of the working surface, he rotates the knob (13) and reexamines the motion until he is pleased with how the platform behaves under the guidance of his hand.

We have found that we rarely are asked to change the frictional loading by the many partially sighted people who visit our office. We attribute this to the fact that we normally maintain enough loading to allow our guests to easily distinguish kinesthetically between the line-to-line, and line-traversing motions of the working surface and to have confidence that the working surface will not wander from line to line when being moved to the left or to the right.

The user may also wish to rotate the X-Y Platform about a vertical axis into a position that allows him to work with it more comfortably. This may be particularly important when he wants to write. We have found that our partially sighted subjects prefer to have their writing material aligned with the edges of the working surface, but that there is a wide divergence in the angles at which they like to orient their writing paper relative to an edge of the desk or table that supports the X-Y Platform.

If a closed circuit TV system has its camera mounted vertically with its lens system pointing downward, and if the camera can be rotated through a complete circle about the vertical axis which coincides with the camera's optical axis, then the user can place the X-Y Platform on the desk or table below the camera so that the geometric center of the platform's base plate (1) lies on the optical axis of the camera's lens system. He can then rotate the X-Y Platform through any angle about the vertical axis that passes through the geometric center of its base plate (1) and still view a conventionally oriented image of his reading or writing material on the TV monitor. To accomplish this end in practice, the user centers and aligns his reading or writing material with the edges of the working surface, rotates the entire X-Y Platform through the desired angle about a vertical axis (which approximately coincides with the camera's optical axis and which passes roughly through the geometric center of the platform's base plate) and then rotates the TV camera about its vertical axis until the image on the TV monitor of the reading or writing material is properly oriented.

Recently we painted a carefully centered 8.5 x 11-inch rectangle on the upper face of the X-Y Platform's working surface. We also painted on that face the two lines which are parallel to the edges of the rectangle and which pass through its center. (See Fig. 1.) This rectangular array has aided us in our attempts to ensure that the center of the X-Y Platform's base plate lies on the optical axis of the TV camera and that reading and writing materials are centered and aligned with respect to the edges of the platform's working surface.*

Rather than have the camera rotate about the vertical axis that coincides with its optical axis, it is possible to accomplish the same end by designing equipment that does not permit vertical rotation of the camera relative to its support, but does permit rotation of the camera support about the vertical axis which coincides with the camera's optical axis.**

For a closed circuit TV system that does not have this camera or camera-support motions or their equivalent, changes in the angle through which the X-Y Platform's base plate may be rotated relative to an edge of the supporting desk or table will be at best limited.

*After the lines were painted on the working surface, they were covered with several layers of clear lacquer, and then fine sandpaper was used to eliminate reflected glare.

**The TV camera support in RANDSIGHT II permits this type of camera motion. RANDSIGHT II will be described in detail in a future publication.

In practice, even with a closed circuit TV system that does not allow any effective camera rotation about a vertical axis, small rotation of the X-Y Platform about the vertical axis passing through the geometric center of its base plate will prove tolerable to some users. This is due to the fact that a number of people are willing to view an image of the printed page that is slightly rotated relative to the horizontal. However, this tolerance breaks down for anything but very small angles and is almost nonexistent when the user is viewing a highly magnified image.

Another reason why the X-Y Platform should be located on the supporting desk or table so that the center of view of the TV camera coincides as closely as possible with the geometric center of the platform's base plate is that this ensures that the TV camera will be able to view every part of reading or writing material that is centered and aligned with the edges of the working surface and that does not exceed the dimensions for which the X-Y Platform was designed, without having to move the material relative to the X-Y Platform's working surface.

We originally designed our X-Y Platform so that when it was centered relative to the TV camera's optical axis and when an 8.5 x 11-inch page of typewritten material was placed on its working surface and centered and aligned with the latter's edges, the left-hand margin of the print was seen at the left-hand edge of the TV monitor when the working surface was fully extended to the right; for the normal typewritten line, the right-hand margin of the print was seen at the right-hand edge of the monitor screen when the working surface was fully extended to the left. This very close tolerance in line-scanning span proved unacceptable. It did not allow for the viewing of an unusually long typewritten line without moving the printed matter relative to the working surface, and what is equally important, it deprived the user of a very valuable clue, namely, the ability to determine when he was actually at the extremity of a line by clearly viewing on the monitor both the print and the blank area in the margin. Genensky observed that although he knew that the working surface travel allowed him to return to the left margin of the printed matter, he felt uncomfortable until he actually saw some of the margin to the left of the print.

We solved this problem by redesigning the X-Y Platform so that it always permitted the user to see the margins of his reading matter clearly, provided he used printed material whose extent on any particular page did not exceed the design criteria of the X-Y Platform, and provided he took care to center the platform relative to the TV camera and center and align the printed page relative to the edges of the working surface.

Although we have limited our X-Y Platform's motion to the accommodation of standard typewriter paper (8.5 x 11 inches), we could, for example, have designed it to accommodate legal writing pads (8.5 x 14 inches) or computer printout sheets (15 x 11 inches). We did not choose to do so, because in our daily work we had little need to use materials having those dimensions. If someone needed to work with such materials frequently, then of course it would be advisable for him to have the use of an X-Y Platform that could handle them. However, we would caution the reader not to become too overzealous in designing large X-Y Platforms, because when platforms are endowed with large line-to-line and left-to-right motions, they require large areas in which to maneuver. For example, a 20 x 16-inch working surface which is to accommodate material which measures 16 x 14 inches may require a maneuvering space that measures about 36 x 30 inches.

Throughout the rest of this section, we will assume that the X-Y Platform has been rotated about the vertical axis passing through the geometric center of its base plate, that the TV camera or its support has been rotated to compensate for the platform rotation, and that the latter has been centered relative to the TV camera's optical axis.

To read with the X-Y Platform the user first (a) places reading material on the working surface, (b) centers and aligns it with respect to the edges of that surface, (c) pulls the working surface toward him until the top line of the material is visible and at a convenient height on the monitor screen, and (d) moves the working surface to the right until the left margin of the reading matter is clearly visible on the screen. He then (e) moves the working surface to the left and reads the words on the top line of the page as they pass by on the monitor screen. When he comes to the end of the line, he (f) pushes the working surface rapidly to the right until the left margin is again visible on the screen. He then (g) pushes the X-Y Platform away from him until the second line has moved to the height on the screen which had been previously occupied by the first line. He then (h) pulls the working surface to the left and reads the content of the second line. After completing the reading of that line he (i) moves the working surface rapidly to the right until he sees the left margin. He then repeats steps (g) through (i) for each successive line until he reaches the bottom of the page. He then turns to the next page and repeats the procedure outlined above.

For reading material that tends to lie fairly flat by itself, it is advisable while reading to maneuver the working surface without touching the reading material. This avoids any tendency to move the reading matter relative to the working surface (once the reading material has been centered and aligned with the edges of that surface). However, if the reading matter does not lie flat, it may go out of focus and it may be necessary to use the fingers of one hand to make sure that it stays in focus. If a strong light source is available and a high quality lens is used on the TV camera, it may be possible to increase the illumination on the reading matter, stop down the lens, and thus obtain a greater depth of field which in turn would produce a clear image of a curved page with either less assistance from the fingers of one hand or no assistance at all.

Figure 4 shows RANDSIGHT I being used for reading with an X-Y Platform. In that figure the operator is using both hands to maneuver the X-Y Platform's working surface, even though the surface of the material being read does not depart very much from a planar surface. However, note that the user's fingers do not touch the printed material because they are not needed to make the surface of that material conform more closely to a plane.

Figure 4 also shows two TV monitors. Either one of the monitors may be used for reading or writing, though left-handed people prefer to use the right-hand monitor, particularly when writing, and right-handed people prefer to use the left-hand monitor. We have found it convenient to have two monitors available for two additional reasons: (a) Our guests and subjects can watch on one monitor what Genensky or one of the subjects is doing with our RANDSIGHT instrumentation using the other monitor, and (b) Genensky can observe on one monitor what a subject is viewing on the other.

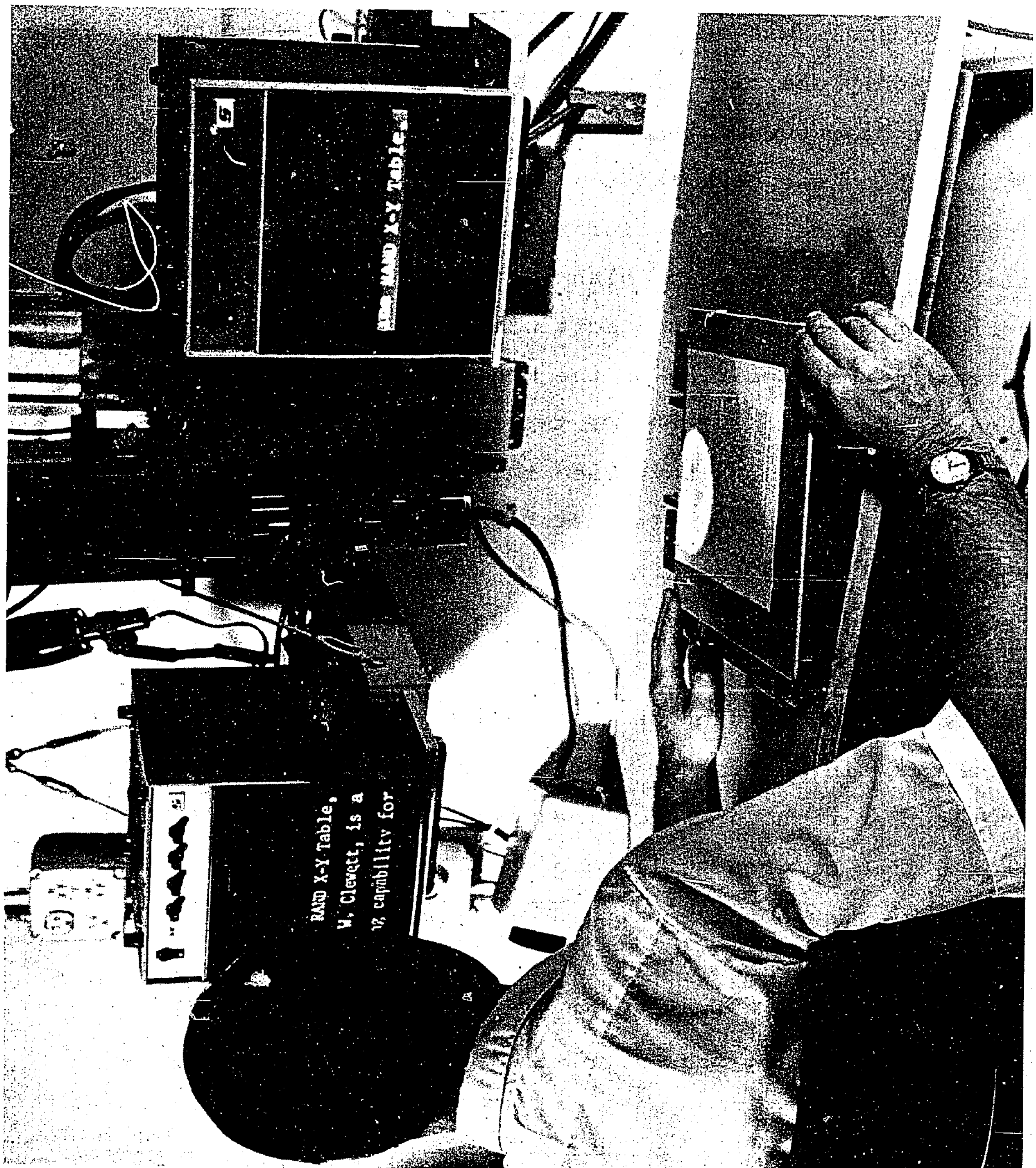

Fig. 4—X-Y Platform being used for reading in conjunction with RANDSIGHT I

The figure also shows images on both monitors in which the gray scale has been reversed, but on the left-hand monitor only one line of print is visible. Image reversal has been discussed in one of our previous papers,* but to date nothing has been written about introducing circuitry that allows one or more lines of print or handwriting to be electronically masked or blanked out. With this additional option we can present subjects who are confused by parts of several lines appearing on the monitor screen at one time, with an image of only one or two lines. Genensky and some of our subjects have used this electronic window with considerable success. It must be pointed out, however, that when the blanking circuitry is in use, it is imperative that reading and writing material on the X-Y Platform's working surface and the platform itself be very carefully aligned so that lines of print or handwriting seen on the TV monitor screen remain horizontal when the working surface is moved to the left or right or from line to line. If this is not done, then a line of print will tend to move partially or totally out of view when the working surface is moving to the left or to the right.

To write with the X-Y Platform the user first (a) places his writing pad or writing paper on the working

*S. M. Genensky, Closed Circuit TV and the Education of the Partially Sighted, The Rand Corporation, P-4343, March 1970 (Also published in Educational Technology, Vol. 10, No. 8, August 1970, pp. 27-31).

surface, (b) centers and aligns it with the edges of that surface, (c) pulls the working surface toward him until the line on which he wishes to begin writing appears at a convenient height on the monitor screen, and (d) moves the working surface to the right until the left margin of the writing material is clearly visible on the screen. He then (e) places his nonwriting hand on the working surface and on an edge of the writing pad or paper, (f) moves his pencil or pen up the left-hand margin of the writing material until he sees it on the monitor screen, and (g) positions the pen or pencil to commence writing.

The actual process of writing may sound complex, but in reality is very simple and is mastered in a matter of minutes by most users. It is accomplished as follows: the user (h) writes holding his pen or pencil in his writing hand when he writes and (i) pulls the working surface to the left with his other hand at a rate which permits the writing end of his pen or pencil to be seen on the monitor screen at all times. Genensky finds it convenient to move the working surface to the left at a rate which just compensates for the rate at which he is writing. This permits him to view the writing end of his pen or pencil at roughly the same place on the monitor screen whenever he is actually putting symbols on paper.

It is important to point out that the hand that guides the working surface also must act to hold the writing paper or pad fixed relative to that surface. If this is not done, single pages will tend to move around the working surface when the user is trying to write and, although writing tablets will tend to undergo less motion most of the time, they too will exhibit considerable motion when the user is trying to write on them near the bottom of a page. We have found that in the case of a single sheet of writing paper or as many as ten sheets of such paper, part of the problem can be alleviated by using one or more small strong magnets to fix the position of the paper relative to the working surface.*

When reaching the end of a line, the user (j) lifts his pen or pencil from the paper and with his other hand (k) pushes the working surface to the right until the left margin of the writing pad or paper is clearly visible on the monitor screen. Using his writing hand, he then (l) pushes the working surface away from himself until the next line on which he wishes to write is in the position previously occupied by the last line upon which he wrote. Steps (f) through (l) are repeated until the user reaches the end of the page, and the whole process, starting with (a), is repeated for each page until he completes his writing.

Figure 5 shows RANDSIGHT I equipped with an X-Y Platform being used for writing. Note that the operator is

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*This, of course, is only possible if the working surface contains sufficient ferromagnetic material to be attracted by the magnets.

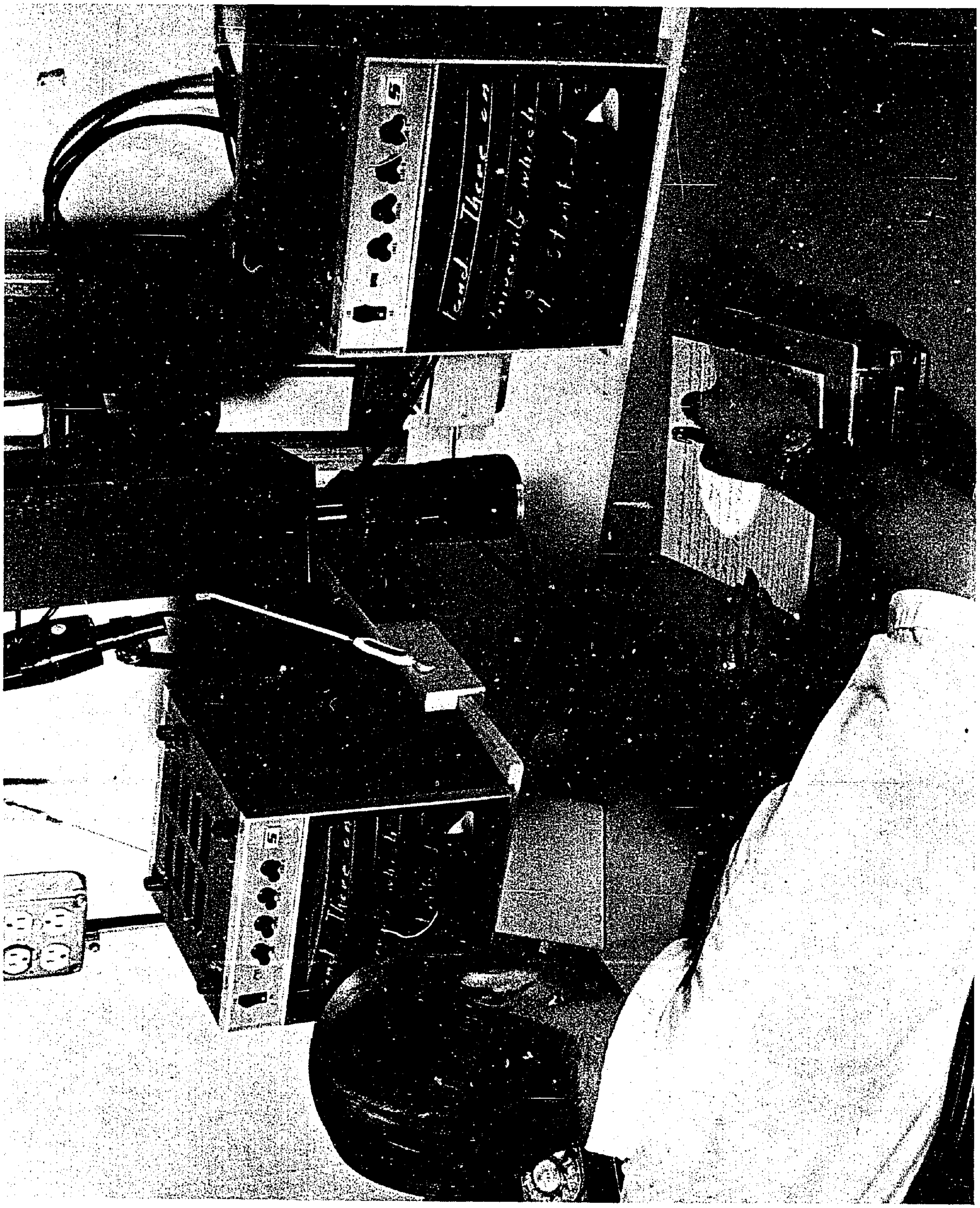

Fig. 5—X-Y Platform being used for writing in conjunction with RANDSIGHT I

writing with his right hand and using his left hand to hold the writing tablet in place and to maneuver the working surface.

IV. CONCLUDING REMARKS

Closed circuit TV systems for the partially sighted which involve the use of an X-Y Platform like the one described in this Report are simpler, less costly, and more effective than many other more complicated instruments.* They are also vastly superior to devices that require a user to maneuver reading or writing materials along a desk or table top with no aid other than human hands. For these reasons, we thought it advisable to summarize the items that we believe should be incorporated in the design and fabrication of a high-quality X-Y Platform. Most of these items have been treated in more detail in Sections II and III.

1. Select drawer slides on the basis of their availability, capability to provide smooth easy motions under the anticipated loading, and ease of adaptability to the contemplated design and cost.

2. Keep overall platform thickness small (preferably less than 2 inches).

3. Make platform sufficiently massive and maintain a good balance between the mass of its moving and its stationary parts.

4. Provide for enough travel in the drawer slides to guarantee that all margins are clearly seen on the TV monitor

*For example, RANDSIGHT I as described in the references given on page 2.

screen when reading and writing materials for which the platform is designed are properly centered and aligned.

5. Fabricate a large working surface to fully accommodate most or all of the materials that it is expected to support.

6. Include a mechanism to provide an adjustable friction in the line-to-line motion of the working surface.

7. Eliminate or minimize the possibility of injury to fingers occurring as a result of platform motions.

8. Round and smooth all exposed edges.

9. Mount drawer slides precisely parallel.

10. Choose for the working surface a pleasing neutral color with a gray equivalent on the TV monitor that is clearly distinguishable from that of common reading and writing materials.

11. Select for the working surface a low-reflectivity finish that will not give rise to excessive glare when viewed directly or on the TV monitor.

12. Paint or otherwise introduce a rectangular array of broad, high-contrast lines on the working surface to act as margin guides.

13. Incorporate a ferromagnetic material in the working surface.

14. Select a material to cover the underside of the base plate that will prevent the platform from slipping but will permit the platform to be rotated or translated when desired.