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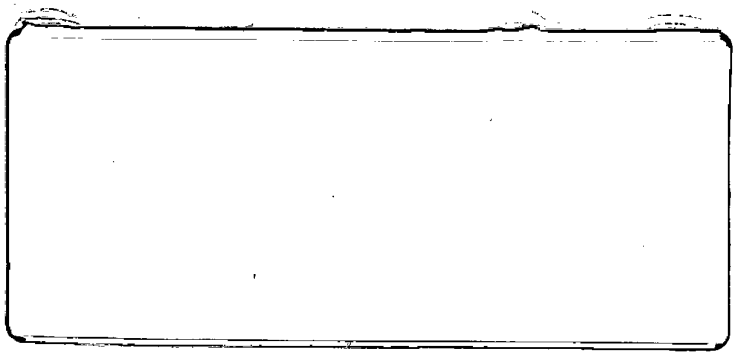

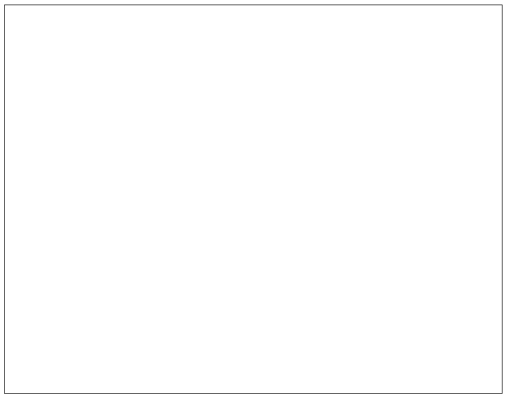

STAT

STATUS REPORT

for Period

1 February through 28 February 1970

U. S. GOVERNMENT

STAT

STAT

This document is presented as the Monthly Status Report under Contract to the U. S. Government, [redacted] STAT
The report period represented herein covers the period 1 February through 28 February 1970.

[redacted] STAT

[redacted] STAT

INDEX

APPENDICES

PROGRAM STATUS SUMMARY

Scheduled Percentage of Completion	85.0
Actual Percentage this Date	80.9

The program schedule has slipped one week since the schedule of December 1, 1969. This is due to difficulties with the checkout of the optical assemblies.

The anticipated shipping date from Paris, France to Berkeley, California has thus changed from April 21 to April 28, 1970. Every attempt will be made to recover the time, but it is presently too early to predict if this can be done.

A meeting is scheduled for March 9, 1970 with [redacted] the Image Analysis equipment supplier. It is presumed that difficulties with their acceptance test procedures will be resolved at that time. There is no indication at this time of a schedule slippage due to this situation.

STAT

TASK 11

STAGE DRIVES

Scheduled percentage of completion	100%
Actual percentage this date	95%

Work is proceeding on the final servo loop compensation for the stage drives. A compensation network utilizing a limited bandwidth rate loop and a position loop containing an additional intergrator has been constructed and tested.

The steady state accuracy of this system appears to be well within specification. However, due to the limited bandwidth of the rate loop, it was found that the system stiffness at frequencies above 1Hz is somewhat marginal. This is evident in operation by the presence of velocity jitter at very low speeds and fairly large overshoots during prepositioning operations or rapid movement of the joystick control.

A second compensation system utilizing a relatively large bandwidth rate loop with a current limit in the servo amplifier is being attempted in order to improve the system stiffness but thus far the results have not yielded a stable position control system. The need for either limiting the rate loop response or limiting the current supplied to the servo motor (in effect limiting the motor torque) arises from the fact that the stage assembly can only tolerate certain acceleration levels. The original design of the stage was for 10"/sec^2 acceleration limit but

it has been found that the system will tolerate 32"/sec^2 accelerations.

Due to the extremely high gain of this servo system (over 10 million at DC) it is fairly difficult to restrict the bandwidth of the various loops without introducing excessive phase shifts.

In investigating possible mechanical improvements to correct the undesirable servo compensation conditions, the tightness of the coupling between the motor and the tachometer has become suspect. This situation has not been resolved as yet but no basic difficulty in making suitable corrections is anticipated.

TASK 12

FILM DRIVE AND TRANSPORT SYSTEM

Scheduled percentage of completion	100%
Actual percentage this date	95%

Work associated with replacing the microswitch assemblies for more accurate units to sense the dancer arm position continued during this report period.

TASKS 16, 17 & 18

VIEWING OPTICS, VIEWING ILLUMINATION, RETICLE PROJECTOR and ILLUMINATION

Scheduled percentage of completion	96%
Actual percentage this date	95%

The optical subcontractor, [redacted] STAT has completed the fabrication of the Stereocomparator optical assembly.

Their work presently consists of checking out the optical electromechanical subassemblies as installed in their acceptance test fixture.

The preliminary results show that the resolution at 200X magnification is of the order of 1,000 line pairs per mm and the light level at the eyepieces exceeds the anticipated values.

The acceptance tests of the optical assembly is scheduled to begin on March 23, 1970.

The latest trip report of the [redacted] coordinator to [redacted] SSTAT is included in Appendix II.

Four photographs showing the [redacted] acceptance test STAT fixtures and some of the optical subassemblies in their housings are included in Appendix III.

TASK 22

INTERFEROMETER ASSEMBLY

Scheduled percentage of completion	100%
Actual percentage this date	75%

The new interferometer circuit boards mentioned in the last monthly report have now been fabricated and test satisfactory.

The photo field effect transistors appear to have some roll-off in their response at high frequencies (corresponding to high stage speeds) due to internal capacitance. This high frequency roll-off is being remedied by appropriate circuit network compensation.

Adjustment of the interferometer measuring systems is proceeding.

In the previous report, a method of eliminating the return beam from the interferometer to the laser by means of extending the path length of the laser beam was described. A set of corner cube retro-reflectors has been obtained and installed and it was found that greatly improved results were obtained. However, in order to restrict the angular deviation of the return beam to within limits acceptable for measuring accuracy and to still prevent the return beam from reentering the laser, it appears that two passes through retroreflectors would be required due to the limited space available on the stage for mounting such a system.

It should be noted that the coherence of the light was not adversely affected by the passage of the laser beam through the corner cube retroreflectors.

Task 24

IMAGE ANALYSIS SYSTEM

Scheduled percentage of completion	95%
Actual percentage this date	95%

The Image Analysis System hardware has been manufactured by Itek and has been tested by them using unapproved [ ] STAT test procedures.

Because of this, [ ] has not at this time accepted the STAT equipment and a meeting has been scheduled for March 9, 1970, to resolve the difficulty.

The meeting is to be held at the [ ] STAT and will include the Itek engineering personnel most knowledgeable about the problem.

TASK 25

OVERALL SYSTEM LOGIC

Scheduled percentage of completion	85%
Actual percentage this date	85%

In checking out the stage drives, it was found that the system used for operation of the track balls and joystick controls in the manual operating mode was unsatisfactory.

As originally designed, the system utilized a 120 Hz clock which strobed the joystick and the track ball commands into the stage position countdown register on a continuous basis. It was found that this caused the stage system to operate in an essentially open loop manner, in that if the joystick was in its zero position (no commands being generated) and no track ball pulses were being generated, the clock caused a string of binary zeros to be loaded into the countdown register 120 times a second. If the stage happened to drift in position during one of the intervals between the clock pulses, any error signal thus accumulated would be cancelled by this strobing action of the clock. Thus, the stage in effect had a position memory which extended in time for only 1/120 of a second and it was possible for the stage to drift away from its set position.

This was remedied for the case of the joystick by arranging gating on the clock signal so that the clock was enabled only if the joystick is moved off center and a motion of the stage is commanded. Thus,

if the joystick is not deflected from its center position, no clock pulses are passed to the countdown register and the stage operates in a closed position loop configuration and will retain the desired position indefinitely.

This same gating arrangement was tried on the track balls and it was found that somewhat erratic operation occurred due to the nature of the track ball system. As presently connected, the track ball consists of incremental encoders which generate a number of pulses per turn of the track ball which are accumulated in a special counter register and strobed by the 120 Hz clock into the countdown register. Thus, it can be seen that as originally constructed the track balls suffer from the same open loop characteristic as the joystick.

Gating was installed such that unless a track ball pulse was generated in the interval between successive 120 Hz clock pulses no strobing into the countdown register would occur. Thus, with the track ball stationary, the closed position loop is maintained.

Unfortunately, it was found that the low speeds track ball pulses occur only once in a number of clock periods, since the strobing of the clock is dependent on the occurence of a track ball pulse. The net result was effectively a variable frequency clock rate. For example, if the track balls were turned at a rate to generate a pulse every 30th of a second, strobing into the countdown register would occur at a 30 times per second rate (every 4th clock pulse). If the track ball pulses occur at a 15 per second rate, then the strobing also occurs at a 15 per second rate, etc. Thus, it can be seen that at low speeds the clock rate will fall down to frequencies within the pass band of the servo system and

will cause erratic jittering of the stage. This was verified by mounting a microscope in such a manner that motion of the stage could be observed at high magnifications.

Additionally, it was found that, in the fine control position of the track ball scale factor pushbuttons, the somewhat limited bandwidth of the stage servo system (6 Hz) caused the relatively low input signals to the countdown register (represented by small binary numbers) to be cancelled by the clock before the stage could react to them.

It should be pointed out that the conditions described above are not present in the automatic modes of operation of the machine since the computer system retains the position of the stage at all times by means of a separate register and can generate error signals for the countdown register based on the summation of all of the track ball and joystick inputs up to the current point in time.

However, since it is necessary for the operator of the Stereocomparator to be able to accurately position the measuring stages for location of various fudicial and reference points, a design revision is in progress to improve the operation of the system in the track ball mode.

Presently under consideration is a method whereby the track ball pulses are not accumulated in a register and periodically strobed in a parallel fashion into the countdown register, but rather are fed serially into the front and reverse counting lines which are identical to those fed by the interferometer units. No clock would be involved in this case and the track ball would accumulate counts in the countdown register and the interferometer system would cause the counts to be counted off, thus returning the countdown register to a zero point.

It is necessary that foolproof anticoincidence circuitry be installed so that a count up signal from the track ball can not coincide with a countdown signal from the interferometer. This circuitry is being worked out.

As explained above, the A/D conversion of the joystick potentiometer voltages and parallel strobing of the resulting binary numbers into the countdown register was found satisfactory after the clock lockout was installed for the zero deflection state of the joystick.

All of the above work is proceeding and it is expected that definitive results will be obtained during the next report period.

Final debugging of the digital logic is nearly complete with only minor timing and wiring problems requiring attention.

In particular, it was found that some of the forward/backward counters used as countdown registers and stage positioning indicators for the computer system required pullup resistors in order to improve the risetime desired of the various flipflops and gates within the counters so that asynchronous clocking by the computer with respect to the interferometer systems would not cause errors in the counters.

It is expected that the electronic systems will be complete and ready for installation of the optics by the time the optics arrive and final tests can be made with the optics in place and the computer program operating.

TASK 32

COMPUTER

Scheduled percentage of completion	100%
Actual percentage this date	100%

Suggestions for increasing the available memory storage for the Honeywell 516 computer in the Stereocomparator have been discussed with the customer representatives in meetings [redacted] STAT

An increase in core memory was felt to be the most advantageous method since it would have the greatest long term flexibility and, at the same time, would solve the present need for minimizing the use of the punched paper tape for changing the program as the photography is changed on the film platens.

The core memory addition would also provide a proper means for operation of the diagnostic computer programs required for routine calibration and routine service. This diagnostic program requirement for memory storage is very important to the long term economics of the operation of the Stereocomparator.

[redacted] concurred with the customer representatives in their STAT recommendation of a 16,000 word increase in the computer memory.

An outline of the Diagnostic Computer Tape requirement is included in Appendix I.

DIAGNOSTIC COMPUTER TAPES

This proposal envisions two series of diagnostic computer program aids in connection with the preventive maintenance and calibration checkout plans for the Stereocomparator.

A. Preventive Maintenance

The purpose of this computer program tape is to provide a rapid and controlled routine means for operating all computer directable elements of the Stereocomparator system on an individual basis.

In addition the tape would direct the maintenance technician through a teletype printout to perform necessary functions requiring operator attention.

This programmed information would include manual tasks not necessarily associated with the computer operated functions of the Stereocomparator.

The computer tape would exercise all the mechanical moving subassemblies throughout their ranges at a variety of speeds.

The technician would be required to observe the performance of the position readout instruments on the control console and visually inspect the operation of the optical system through the eyepieces and directly observe the operation of the various electro-mechanical drives.

This computer program would not include calibration data.

The computer aspect of the testing would be to initialize an optical parameter by reading the respective potentiometer, execute a command and then read the resulting potentiometer output.

The difference in potentiometer value between predicted and actual would represent drift in the digital/analog converters or the servo system as a whole.

The potentiometer values and the specific parameter under inspection would be printed out on the teletype.

B. Calibration Checkout

The purpose of this computer program tape is to provide the operator of the Stereocomparator with a means of rapidly and readily determining if the instrument is in calibration.

The tape would be used with a standardized pair of Stereophotographs where all the necessary parameters were known.

The prepositioning system would be used to select the specific points of interest on the photographs where the standardization had been previously performed.

As each point is reached the computer-read optical parameters will be printed out on the teletype. These values will then be compared by the computer with the correlator error signals. These offset values will be printed out on the teletype for review by the operator.

The operator will also look through the eyepieces to determine that the photographs represent optimum stereoviewing.

The measuring system on the stages will be checked out by remeasuring the selected measurement points on the standardized photographs.

C. Parameters To Be Checked On The Following Subassemblies

1. Illumination level constant with change in magnification.
2. Illumination level varies with change in film density.
3. Reticle size remains constant with change in magnification or change in anamorph ratio. This is at various degrees of image rotation.
4. Reticle spot size selection from the control console.

5. Reticle spot color selection from the control console.
6. Reticle spot illumination level selection from the control console.
7. Illumination level selection from the control console.
8. Illumination level selection from the eyepiece block.
9. Illumination color selection from the eyepiece block.
10. Operation of excess illumination eye safety shutters in the eyepiece block.
11. Operation of anamorph optics.
12. Operation of magnification optics.
13. Operation of image rotator.
14. Operation of anamorph rotator.
15. Operation of stages and laser interferometer system.
16. Operation of correlator.
17. Operation of digital to analog and analog to digital converters.
18. Operation of servo systems.
19. Operation of control console manual controls.
20. Operation of optical parameter readout instruments on the control console.
21. Operation of the individual eyepiece adjustments.
22. Operation of the eyepiece switching at the eyepiece block.
23. Operation of the electronic system as a whole.
24. Operation of the film handling equipment including vacuum clamping and stage positioning for film loading.
25. Checkout of control console as a whole.
26. Objective switching.

JOB #342

TRIP REPORT

Company Contacted: [redacted] STAT

Contacted By:

Contact Date: January 23, 1970, through February 6, 1970

Purpose: Technical review of Stereocomparator optical fabrication

The status of the various optical subassemblies was determined during the visit and is summarized below:

1. Right Main Condenser Zoom
   The new motor and the inertia-minimizing gearing change have been incorporated. The microswitches are set. The subassembly is complete.

2. Left Main Condenser Zoom
   Same as the right condenser zoom except, in addition, this subassembly has been installed in the acceptance test fixture.

3. Potentiometer Setting for the Right and Left Main Condenser Zoom
   The microswitch/cam is set through a slot cut in the side of the condenser housing by matching a marked line to an index behind the potentiometer mount. The potentiometer itself must be set to zero. The condenser drive is adjusted by hand-rotating to the index mark which represents the center of travel with respect to the 40mmf objective system.

4. Right Main Illumination System

The adjustable diaphragm subassembly, which includes the removable portion of the motors, gearboxes and tachometers, is complete. Additionally, the new larger motors and the inertia-minimizing gearing have been incorporated.

A technical difficulty concerning elongation of holes for final alignment in mounting to the [ ] interface at the time of final assembly is anticipated. Solution may have to await arrival of the optics [ ] STAT STAT

The holes are now correct for the acceptance test fixture at [ ] There is no adequate solution except to modify the mounting holes after the optical parts have arrived [ ] STAT STAT

[ ] has provided a tool for setting the gearing in its matched position for reassembling the removable motor plate. In the case of the main gear the potentiometer is to be set at 6.25 volts by rotating the diaphragm assembly. STAT

5. Left Main Illumination System

The comments for the right illumination system apply to the left system except, in the adjustable diaphragm system the potentiometer is to be set at 6.35 volts when reassembling the motor plate.

6. The right and left main illumination systems are completely finished and installed on the acceptance test fixture.

7. A technical difficulty was observed concerning focusing when changing the main illumination system lamp.

To adjust the plane of the arc, it is first necessary to rotate the switchable optics out of their normal position (by approximately 45°) and place a prism immediately after the lamphouse.

Next, an auto collimating telescope is placed to the side and the lamp plane is adjusted to the required position using the infinity setting of the telescope. The light beam from the condenser is collimated.

The transverse and vertical positions of the lamp are set by removing the filter wheel assembly and inserting a horizontal "screen" (paper and density filter). The arc is then adjusted to center it.

The mirror behind the lamp is then adjusted so that the direct image and the reflected image support each other to obtain the properly oriented image combination.

In reviewing this process it was clearly too cumbersome for routine lamp changing. The [redacted] technical representative has therefore requested tha[redacted] provide some form of tooling which requires removal of the lamphouse and setting the lamp position accurately by an adjustment on the bench where easy access is available. STAT STAT

8. The three sections of the optical bridge are now in place on the acceptance test fixture. The center binocular eyepiece section is fully assembled. Most of the subassemblies have been installed in both of the right and left optical bridge sections.

The [redacted] cables have been installed in the optical bridge. Some cables are too long and some rework may be required. STAT

9. A plug and receptacle are mounted on each inner side of the main rotating anamorph assembly. They face towards the front of the machine and protrude about 8 cm past the skin. It is clear that the receptacles will have to be relocated.

10. In general, care must be exercised not to use excessive force in handling the plugs on or off the receptacles since unnecessary mechanical stress could upset the optical alignment.

11. Left Reticle Illumination System
This subassembly is complete except for adjusting the potentiometer on the filter wheel.

12. Right Reticle Illumination System
This subassembly is mechanically complete but has not been aligned or optically adjusted, nor has the potentiometer yet been mounted.

13. Left/Main 10x Zoom
This assembly is entirely finished and is awaiting assembly into the [ ] optical bridge. STAT

14. Right Main 10x Zoom
Same as the left main 10x zoom except the potentiometer Cup #3, was damaged (broken terminal). This cup provides a drive for the main illumination system.

The spare Cup #5 linear, was substituted for Cup #4 which was in turn substituted for Cup #3.

15. [ ] has provided a main illumination cooling system consisting of an air distribution system with about 8 tubes on each side. [ ] had not provided the plastic tubes so [ ] procured their own. STAT STAT STAT

16. The cables for connecting to the main illumination system are not yet available. They are due for completion soon at [ ] STAT

17. The reticle illumination system lamp starters cannot be installed as planned because of an error in the dimensioning of the base plates. This is being corrected [ ] STAT

18. [ ] is working two 8-man shifts, namely 06:00 hours to 15:00 hours and 12:00 hours to 22:15 hours, Monday through Friday. A single crew works 06:00 hours to 12:00 hours on Saturday. STAT

19. Various potentiometers were damaged [redacted] STAT either mechanically or electrically during installation. Spares were substituted and no delays or problems resulted.

20. Spares
Any new filter wheels, i.e., spares, should be ordered without the "cover glass" and made from heat resistant glass.

The present spares order should be so modified.

Also, one Servalco motor should be canceled from the two ordered. There is presently already one at [redacted] STAT ordered previously.

21. The reticle lamp electrical system was tested using the special 60 cycle 120v MG set. [redacted] should obtain STAT the instruction book for the PEK series 401A power supply.) The lamp stabilizes at 6a and 17 volts. It is Type HBO 100 Osram.

The Christie IGA7 starter did not start the lamp until the internal potentiometer to increase the voltage was readjusted.

22. During testing of the reticle system, the reticle spot zoom system (which includes a 10x and a 4x zoom) was found to change by only 1.6x.

The light rays from the reticle 10x zoom passed with divergence through the reticle anamorph and the reticle Pechan prism to the 50:1 reducing relay/telescope. Because of this divergence the rays were not collected at the telescope, and the field was occluded. This technical difficulty was solved by designing a relay system to be placed immediately after the 10x reticle zoom.

The relay consists of a front and rear positive (convex) lens with an intermediate negative (concave) lens.

This correction requires mechanical and optical design plus fabrication. [redacted] estimates that, if everything goes perfectly, one to two weeks will be required. This portion of the work is about one week ahead of schedule; thus there may be only a small slippage in the finaly delivery date. STAT

23. On Thursday, January 29th, the complete optical system was installed in the [redacted] left optical bridge and assembled in the acceptance test fixture. This was then aligned with the [redacted] optical bridge alignment fixture and upon lighting the lamp and looking in the left eyepiece - "light was seen." This is a significant milestone for the Stereocomparator. STAT STAT

24. The installation of the optical bridge at [redacted] should proceed in the following order: STAT

a. Install the center portion of the optical bridge.
b. Install the side sections of the optical bridge.
c. Set the [ ] alignment tooling in place and adjust the bridge sections to fit. STAT
d. Set the [ ] optical center illumination tooling in place. STAT
e. Locate the center of the condenser (above the base).
f. Remove the [ ] illumination tooling. STAT
g. Install the condenser (above the base).
h. Install the main illumination system and the below base condenser.

25. On Friday, January 30, 1970, the reticle spot could be seen through the system but it was large and blurred. An afocal telescope (relay) is in the process of design and fabrication to correct this condition. [ ] STAT plans to put this in ahead of the reticle rotator. (Pechan Prism).

26. On Saturday, January 31st, [ ] STAT was ready for a resolution test of the left half of the system. The customer resolution target was used and it was found that at 200x the resolution was at least 1000 line pairs per mm at the film plane on axis. There was about 7% greater resolution in the tangential than the saggital direction.

27. Concerning the variable diaphragm portion of the main illumination system, the 40mm and 80mm objective switching can only occur at the center portion of the diaphragm travel when the output of the ten turn potentiometer is between -0.5v and +0.5v.

[redacted] has been asked to provide special micro-switches for new [redacted] logic to accommodate to this condition. One will "enable" via a new cam over the ± .5v range. The others (2) will show the 40mm and 80mm positions and thus the direction of travel for the new logic to reach the ± .5v position.

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28. The acceptance test problems was presented by the [redacted] representative in a 4-1/2 hour meeting with:

STAT
STAT

[redacted]

The entire acceptance test program was reviewed and the targets were shown. A written outline prepared [redacted] was presented as an example.

STAT

The maximum use of forms was requested. [redacted] was asked to provide as soon as possible the acceptance test procedure and the acceptance testing schedule. February 13th was the date set by [redacted] to provide [redacted] with a handwritten outline of the test procedure and February 18th was the date set for the testing schedule.

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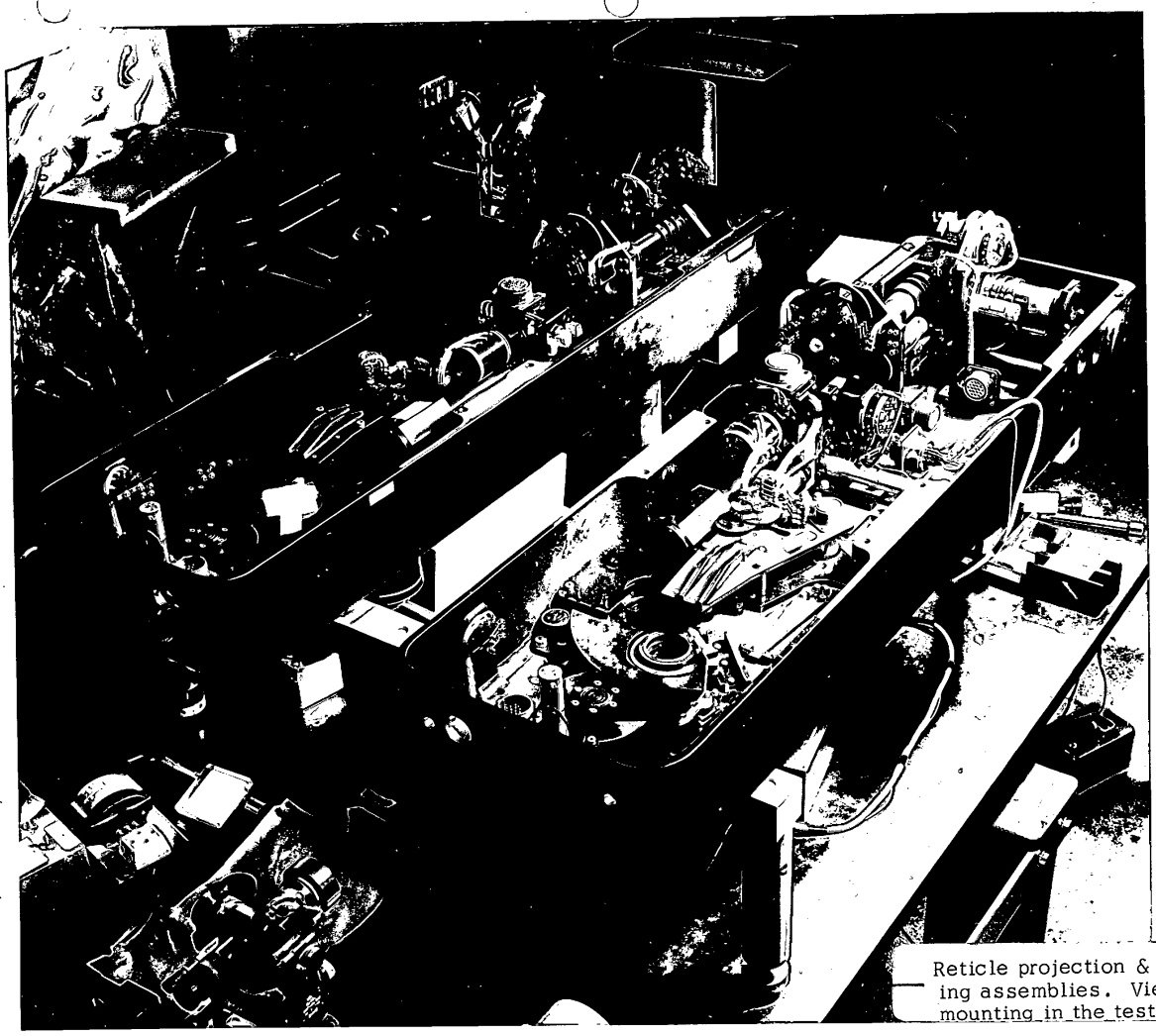
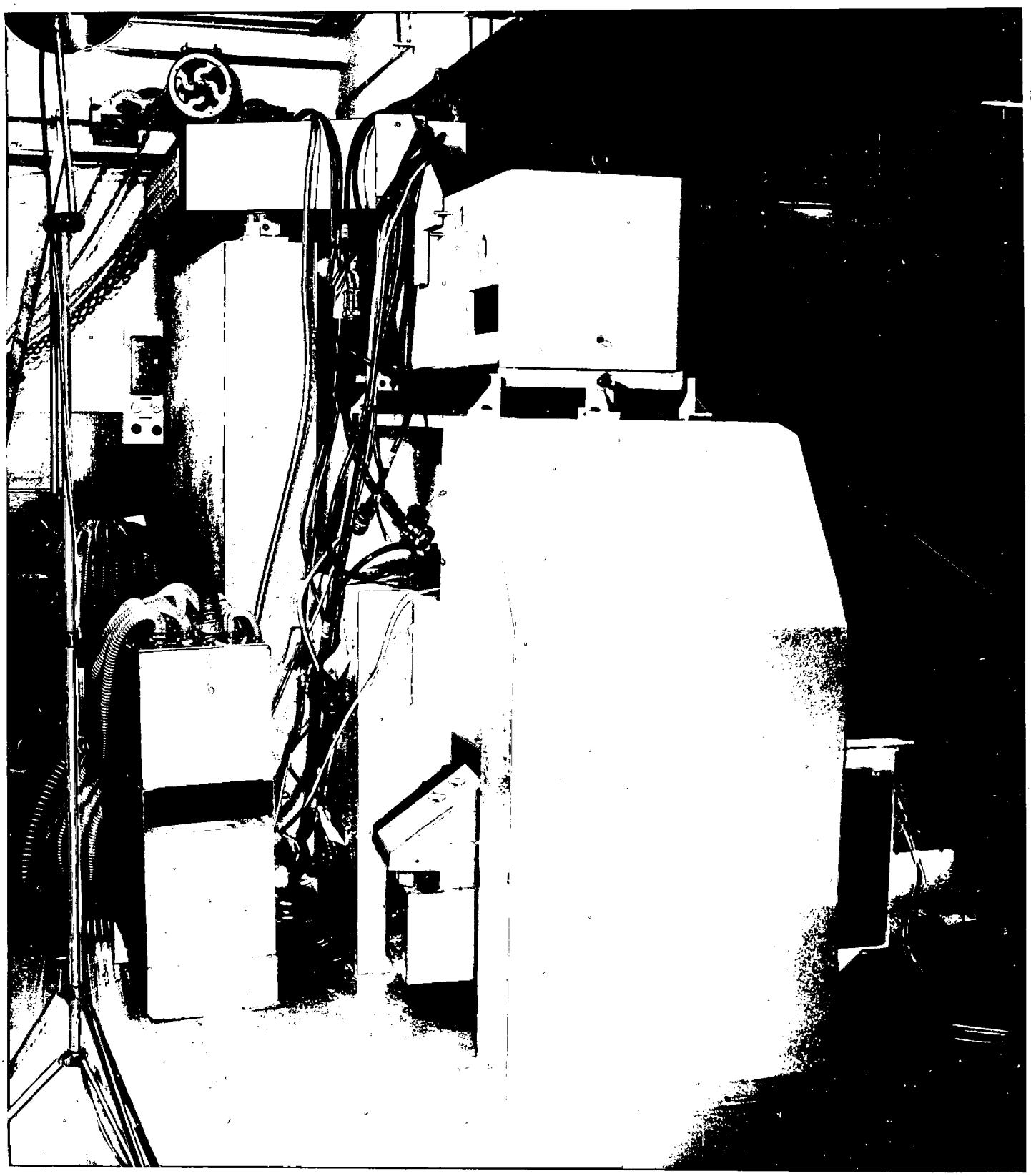
The present (February 28, 1970) schedule is that the optical tests are to start on March 23, and be completed by April 10. Some electronic tests and preliminary work would start on March 16.

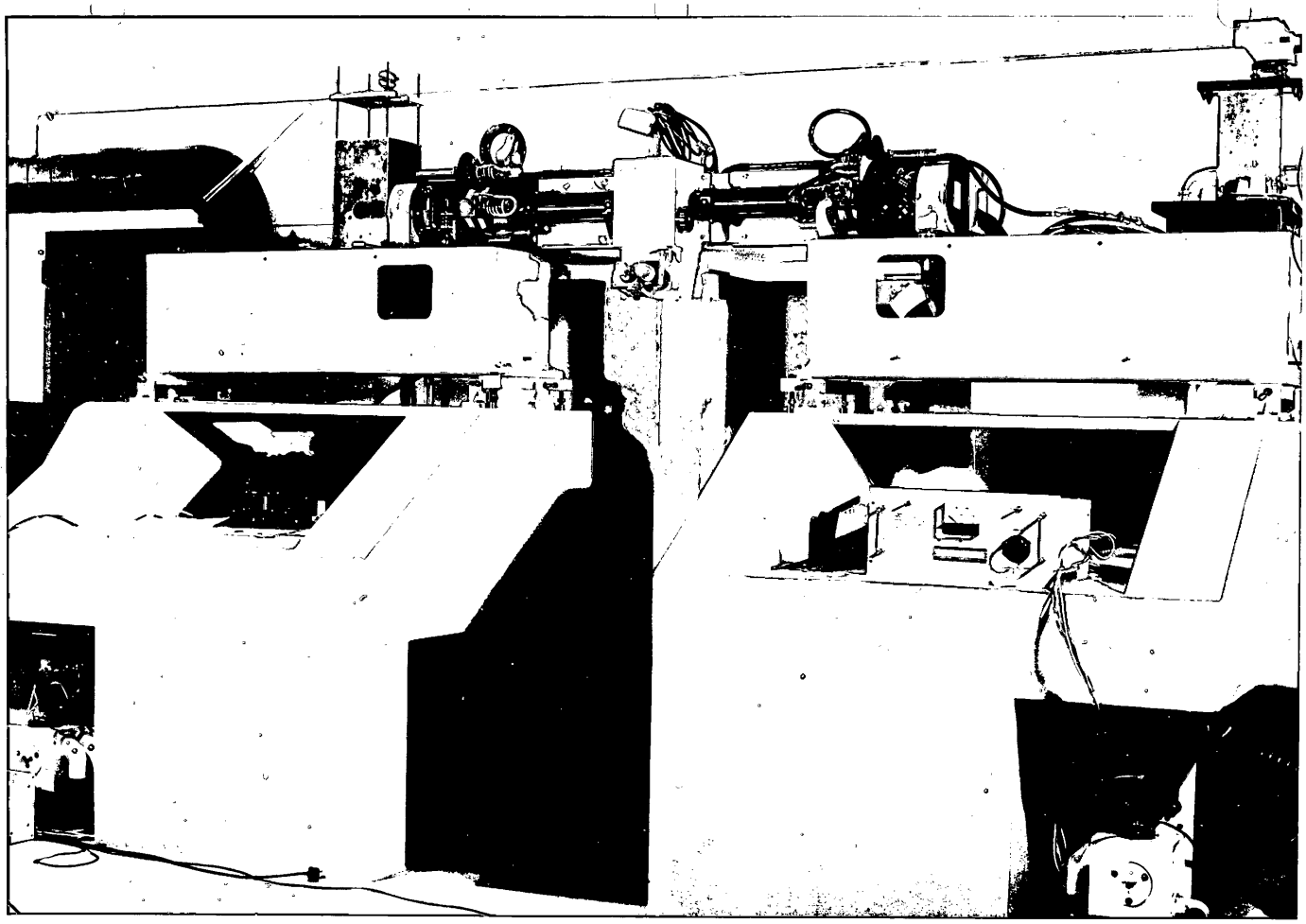


Reticle projection & objective switching assemblies. View prior to mounting in the test fixture. 2/3/70

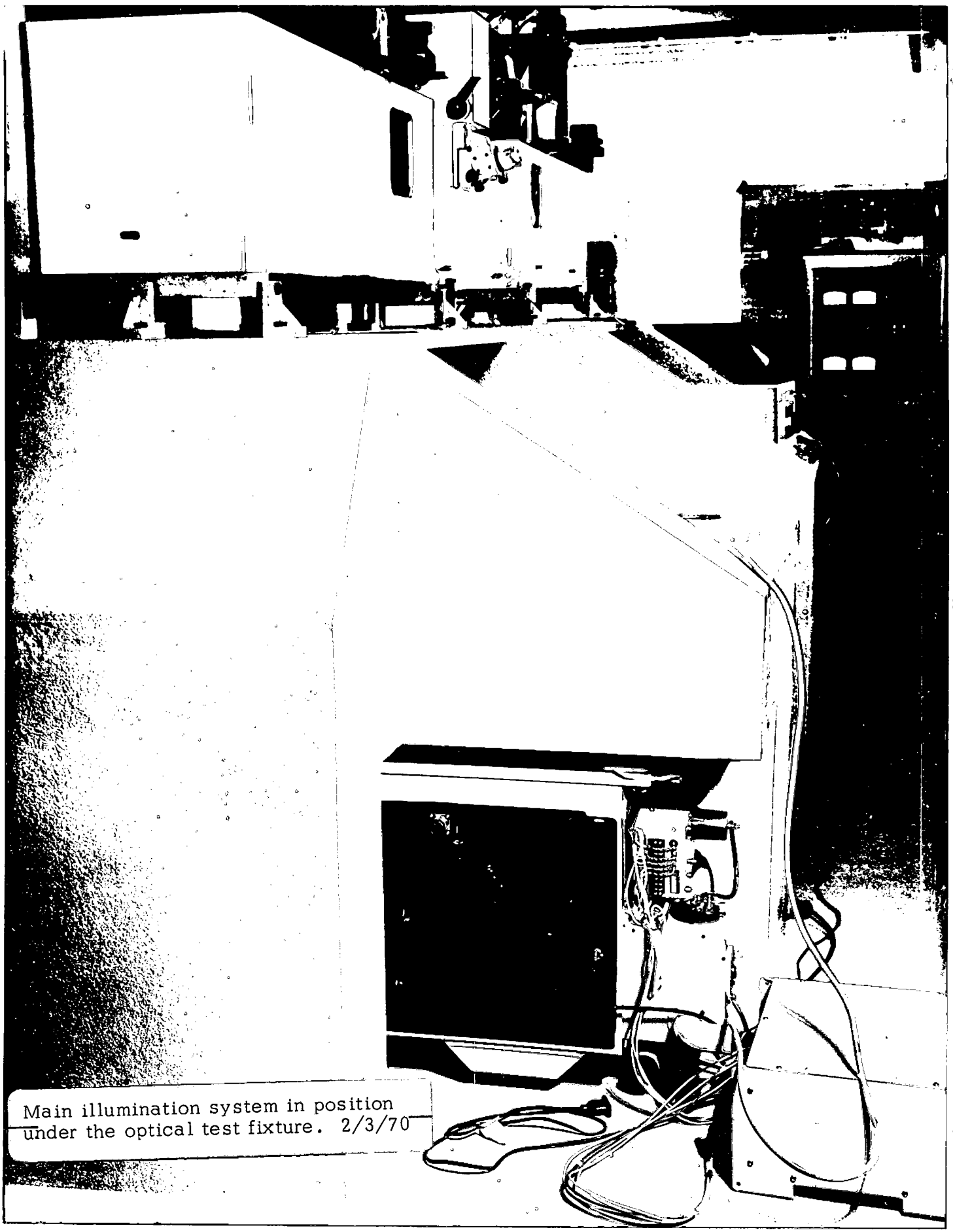


Rear view of optical test fixture showing [redacted] optical bridge sections in place.
2/3/70

STAT



Front view of optical test fixture with optical subassemblies installed. 2/3/70



Main illumination system in position under the optical test fixture. 2/3/70