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SEVENTH QUARTERLY PROGRESS REPORT
ON
PRODUCTION ENGINEERING MEASURE
FOR
TUBE TYPE 7587

DURING PERIOD OF:
1 DECEMBER 1963 TO 29 FEBRUARY 1964
CONTRACT NO. DA36-039-SC-86732
ORDER NO. 19054-PP-62-81-81

PEM & FACILITIES PROCUREMENT BRANCH
U. S. ARMY SIGNAL SUPPLY AGENCY
PHILADELPHIA 3, PENNSYLVANIA

PRODUCTION ENGINEERING MEASURE

for

TUBE TYPE 7587

for period of

1 DECEMBER 1963 TO 29 FEBRUARY 1964

OBJECT

To provide critical facilities for high volume, low cost, production of Nuvistor tube types, with special emphasis on tube type 7587, by the development and construction of an automatic grid lathe, exhaust machine, and lead loader.

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Approved By: for E. Rudolph

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I. **ABSTRACT**

~~This seventh~~ quarterly report contains a detailed account of the problems, actions, and progress encountered in maintaining the operational efficiency of ~~the subject~~ equipment.

~~This~~ report also describes the step-by-step events that occurred in preproduction testing, ~~and shows that the overall status of~~ the contract is on schedule. ~~At the end of this period,~~ it is indicated that all the necessary steps have been taken to allow commencement of the production run.

II. PURPOSE

The purpose of this contract is to obtain high volume, low cost manufacturing capability for the Nuvistor tube type 7587 by the creation of several critical equipment facilities. It is an intent of this contract that the subject facilities inherently contain sufficient flexibility to not only service the tetrode line of Nuvistors, but also a broad spectrum of existing triode types and contemplated future types, such as long leaded Nuvistors.

The contract is divided into six phases; namely the development, design, construction, debugging, testing and evaluation of three main tasks:

1. An automatic banded truss grid winding and brazing machine.

2. An automatic exhaust machine.

3. A semi-automatic lead loader.

This effort not only involves the creation and construction of the subject facilities, but a complete in-production evaluation of equipment performance and product quality.

The contract has joint sponsorship, with the development, design and evaluation costs funded by the Army Signal Corps, and the construction costs funded by Radio Corporation of America.

III. NARRATIVE AND DATA

The seventh quarterly period of the subject contract involved two main efforts:

1. Gradual integration of the new equipment and the existing production line, with emphasis directed towards improving the operating efficiency of each machine.

2. Completion of the preproduction requirements, and formulation of plans for carrying out the pilot production run.

The following narrative is a review of the problems encountered, actions taken, and progress achieved in the above areas of effort during this period.

A. BANDED TRUSS GRID WINDING MACHINE

During this period, the unit was in full production use, winding both triode and #2 tetrode grids. Constant surveillance by Equipment Development personnel was maintained in order to rate machine performance and correct problems as they occurred.

A majority of the difficulties encountered were related to the mandrel feed and guide system. The magazine unit experienced occassional jams which were due primarily to wear or distortion of the rubber roller located at the exit end of the magazine. The purpose of this roller is to constantly urge the bottom mandrel in the magazine foward by virtue of friction, thus assuring a constant supply of mandrels to the roll feed. However, it was necessary to replace the roller at least once a week in order to maintain trouble free operation. Also, particles of rubber were frequently carried into the guide system, causing further jams. As a result, a hardened steel "V" groove roller was substituted. The groove angle was deliberately chosen at 20° included in order to provide the required foward pressure while still allowing the roller to slip ahead of the mandrel. Although this modification operated very well, the roller did occassionally cause scuff marks on the mandrel surfaces. This condition was corrected by reducing the "V" angle to 14° and providing a slip clutch on the roller. Thus, the bottom mandrel is now in a "locking" groove, and the foward pressure is

A. (CONT'D)

obtained by virtue of the slipping action in the clutch.

A second problem area involved mandrel flattening due to the main roll feed. This condition did not become apparent until the same set of mandrels were run through the machine repeatably for several weeks. Although the mandrels are expendable items, and the degree of flattening was progressive, this condition was considered undesirable. With the installation of the "V" groove roller, it was possible to produce higher foward pressures on the mandrel train, and thus relieve the main roll feed from some of the load. This allowed reduction of roll pressures, and eliminated the flattening entirely.

Lastly, because of previous jamming and slippage, the main feed rolls have worn and developed grooves. This will be corrected by shifting the rolls axially to provide new surfaces, and by fabrication of a spare set.

B. EXHAUST MACHINE

The sixteen head exhaust machine continued in full production use except for a downtime period resulting from cooling water leaks and manifold porosity. During December, the unit experienced sudden, temporary pressure rises in the high vacuum system, which occurred sporatically and very infrequently. This condition caused the manifold vacuum to drop two to three orders of pressure for several seconds during operation, and had the outward appearance of a leak that suddenly occurred, and just as suddenly disappeared. One head was removed from the machine and inspection revealed considerable corrosion in the cooling water passages of the end caps. The end caps were removed, subjected to high internal water pressure, and over a period of 24 hours, minute droplets of water appeared on the inner wall. As shown in figure 1, the end caps are a two piece structure that is copper brazed together. This construction allows the inclusion of an integral water cooling passage. By cutting a section through an end cap, it was found that corrosion had progressed along the copper brazed interface until leakage occurred. All aspects of electrolytic corrosive action were studied, but none could account for such rapid progress. However, an analysis of the recirculating cooling system water revealed a high incidence of arsenic

B. (CONT'D)

compounds, which was further traced to disassociation of a rust inhibitor additive. As a result, the entire cooling system for the Nuvistor plant was drained, flushed, and refilled with pure glycol. All heads were removed from the machine, and the end caps were replaced with new units.

In late January, several low level leaks were discovered in the main manifold. This unit was removed, and leak tests revealed porosity in the welds between the head support flanges and the body. All flange welds were rewelded, and the unit was reassembled. The machine was then put back in full production use by mid February.

C. LEAD LOADER

The lead loading unit continued in full production use during this period with no prolbems or downtime. This machine has demonstrated considerable flexibility, due to the low changeover time associated with tube type changes. As a result, a second duplicate unit was fabricated, and is also in full production use.

D. COPPER WASHER MACHINE

During this period, the copper washer machine was operated in the Equipment Development laboratory for the purpose of processing the pre-production samples. It was then moved onto the production floor late in this quarter. The laboratory performance of this unit was very satisfactory, with a yield in the 90% region. However, it must be considered that these runs comprised small lots of product processed under ideal conditions. With the machine in place on the production floor, larger lots of product were run, and it became apparent that output efficiency was variable. On a day to day basis, the percentage ratio of net good output vs. input varied widely within arange from 50% to 90%. The shrinkage criteria used in measuring performance was quite severe. Any defect, repairable or not, was considered detrimental, such as one missing washer, or a slightly tilted grid flange. One or more missing washers representated an insignificant portion of the shrinkage. The single major factor contributing to

D. (CONT'D)

inefficiency was tilted #1 grid flanges. The #1 grid flange is particularly susceptable to tilting in the tetrode because, on a relative basis, it has the least support. The #2 grid flange is located and held by the brazing jig, and the cathode support flange is so small that the leads exhibit a very slight moment arm. The #1 flange is not supported by any member other than the grid, and the leads can exert a tilting action by virtue of a considerable moment arm.

The first attempt to reduce tilting was to reform the the flange to a slightly smaller diameter (.0005") in order to obtain a better press fit on the grid. This did not appreciably change performance on the unit. This led to a first conclusion that the product was not capable of machine processing. However, when product was run without copper strip in the die heads, no tilting occurred.

A second observation indicated that when tilting did occur, it was always in the second die head, and the flanges were always tilted down in the area of the stub leads. From this evidence, it appeared that the stub lead washers only were striking or pushing the leads down. Die alignment was rechecked and found to be excellent. After several more runs, it became apparent that the tilting shrinkage could be varied by changes in the air pressure used to strip the washers from the punches. As shown in figures 2, 3 and 4 two sources of air are injected into the second die head. The upper source is used to strip the washers from the ends of the punches. The lower source maintains a downward rush of air on the long lead clearance holes to prevent lifting of previously loaded washers, and leads during the upstroke of the punch ram.

One the basis that tilting shrinkage could be severly affected and varied by air pressure changes, the air supply for the second die head was replaced with two separate, regulated lines, one for punches and the other for the clearance holes. Both lines contain surge tanks to eliminate regulator resonance. At the end of the period, tests were in process to determine optimum air pressures, and the first data collected indicated that a vast improvement had been made.

E. PREPRODUCTION SAMPLES

During the period of December 18 to 30, 1963, the preproduction samples of Tube Type 7587, were mechanically and electrically tested. All test procedures were witnessed by Mr. S. Zucker of USAEMSA and results reviewed and approved. Out of a sample lot of 41 tubes, 18 were tested for all electrical characteristics, and 11 were subject to 500 hour intermittent life test. Two groups of five each were taken from the lot of 18 and subjected to fatigue and shock tests. The group on shock test failed, and a second lot of 12 was resubmitted. This second group passed. At this point, Mr. Zucker pointed out that a conflict existed between the RCA specification for Tube Type 7587, which calls for stability, survival, and particles indicator testing of 150 tubes, and the contract, which calls for only 28 preproduction samples. As a result, a TAR was initiated to allow inclusion of these tests.

On January 29, 1964, a TAR #FEB-1, dated 8 January, was received allowing inclusion of 150 additional tubes in the preproduction run in consideration for a reduction in production run quantity from 2000 to 1850 units, and one month contract extension. These tubes were processed and tested under Signal Corps surveillance. At the end of this quarterly period, the results were compiled in a report which will be an addendum, to the original test results. These total test results indicated compliance with specification and should result in approval.

Also during this period, a coded engineering letter #688-47, dated January 8 was submitted along with a report describing the test equipment used for preproduction testing. At the request of Mr. T. Kyne, Chief, Production Engineering Division, USAEMA, a production line flow chart of the 7587 manufacturing process was prepared and submitted. Lastly, during the latter part of February, a quality control plan, governing the procedures to be used in the production run, was submitted.

F. TABLE OF FIGURES

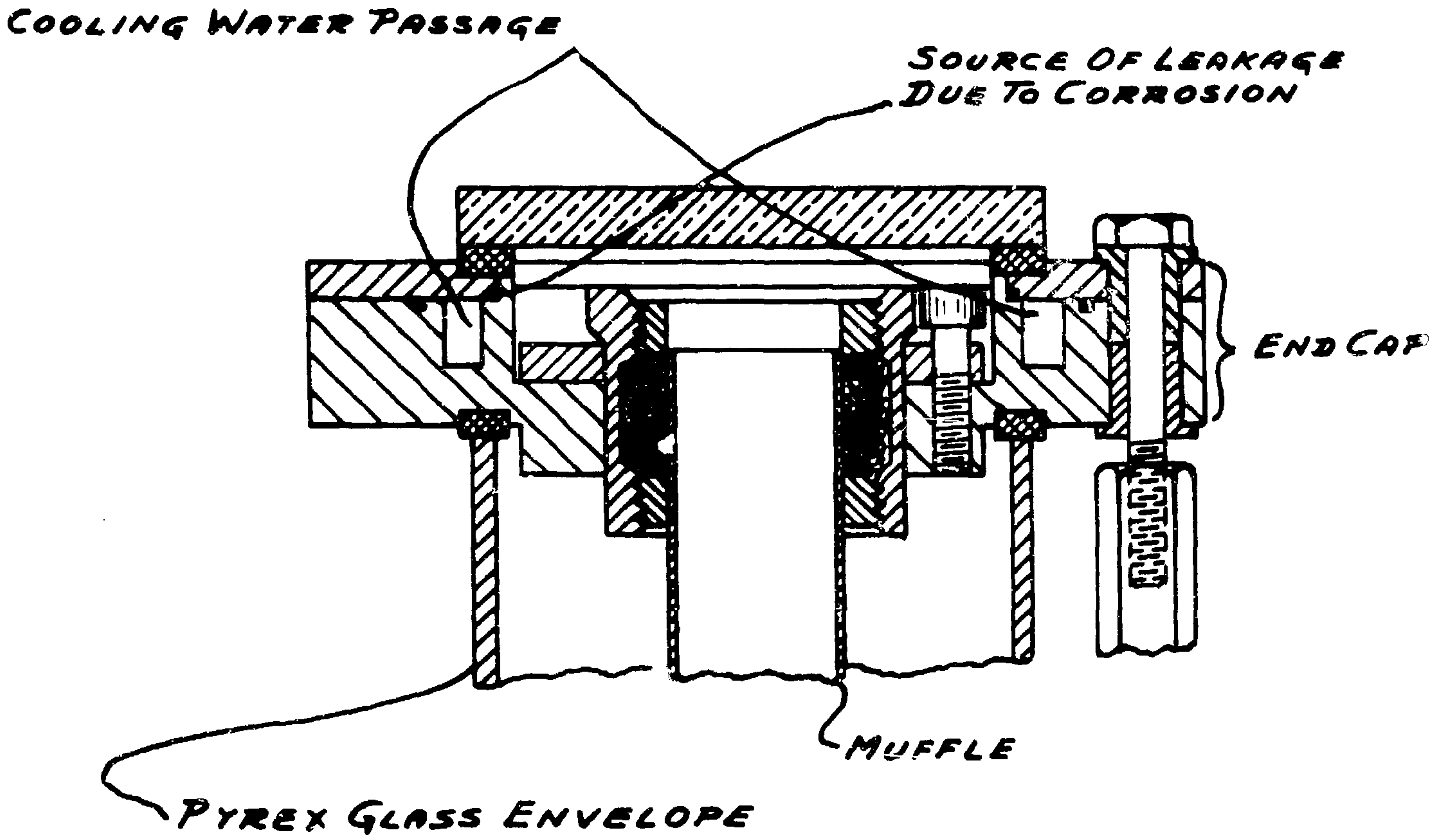
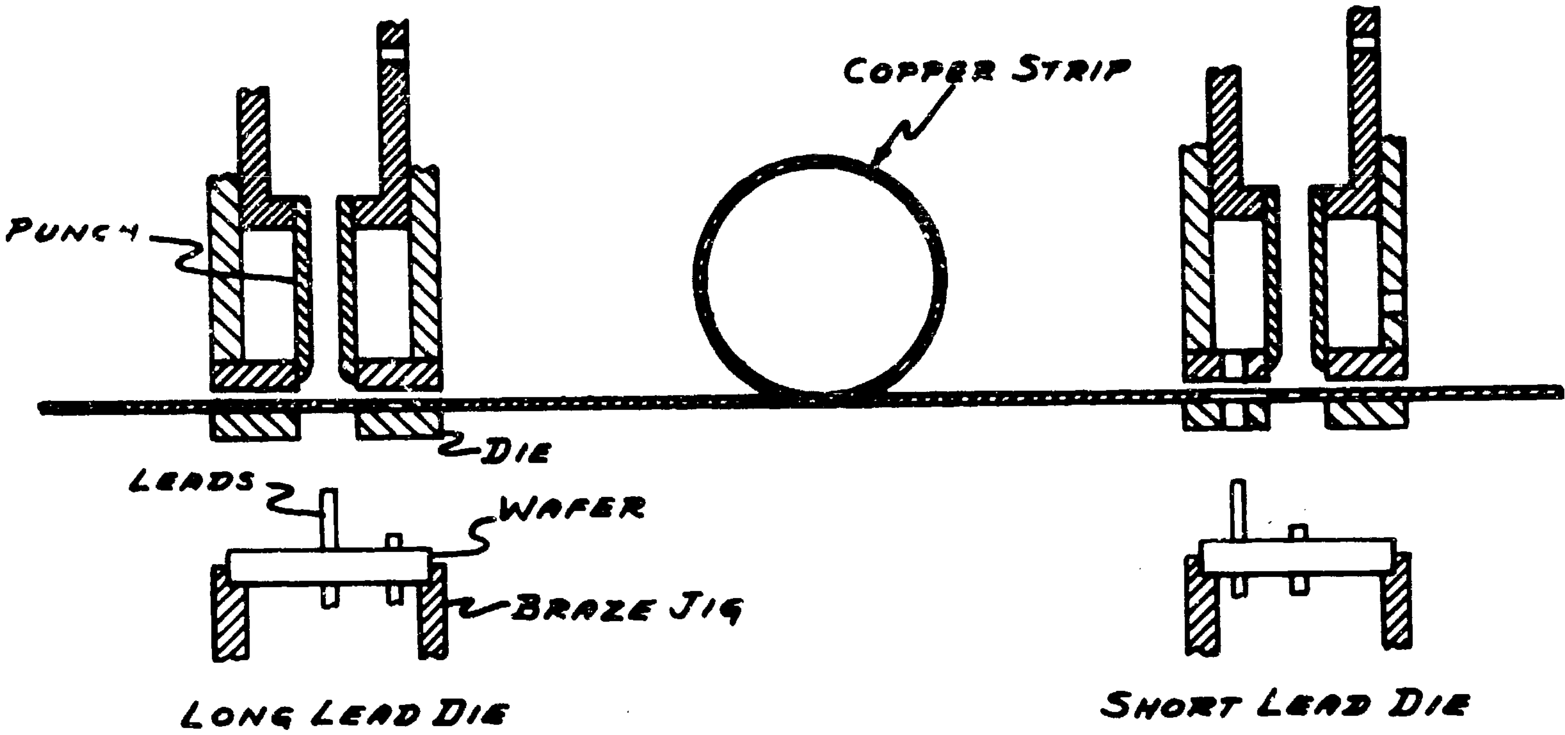


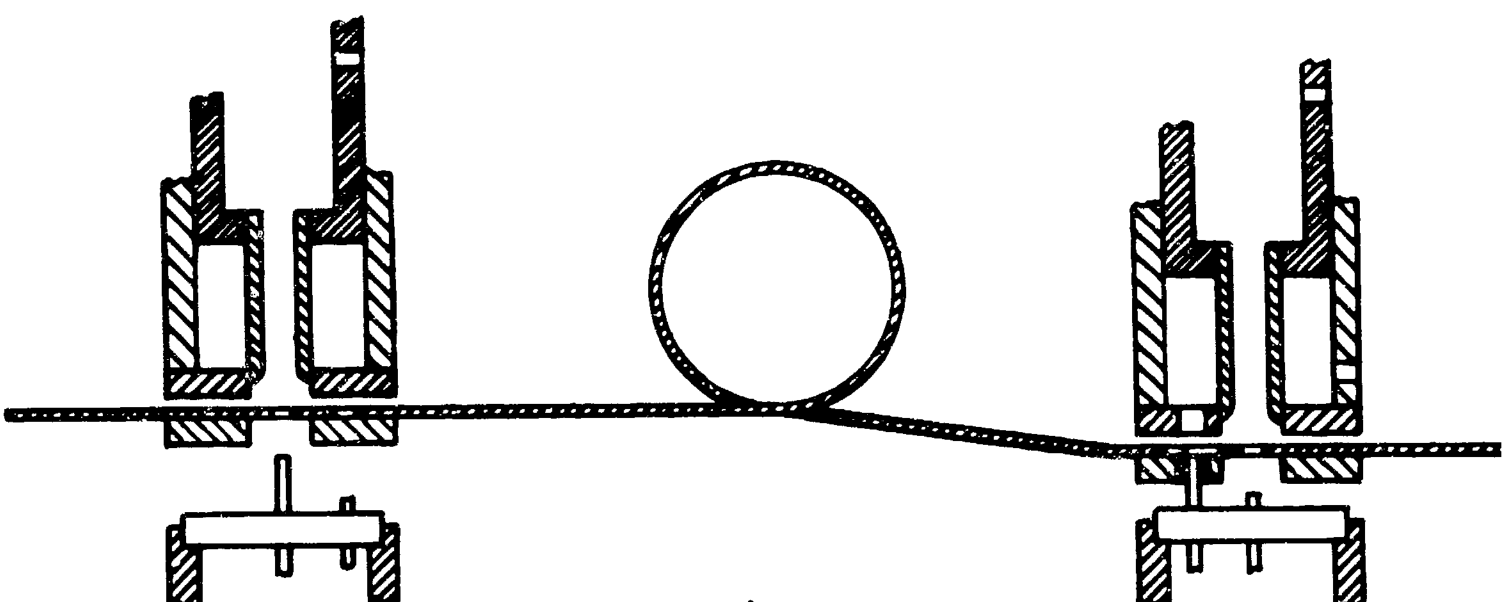
FIG. 1

CROSS SECTIONAL VIEW OF A TYPICAL END CAP FOR THE EXHAUST MACHINE



a

END OF TURRET INDEX - DIE HEADS UP

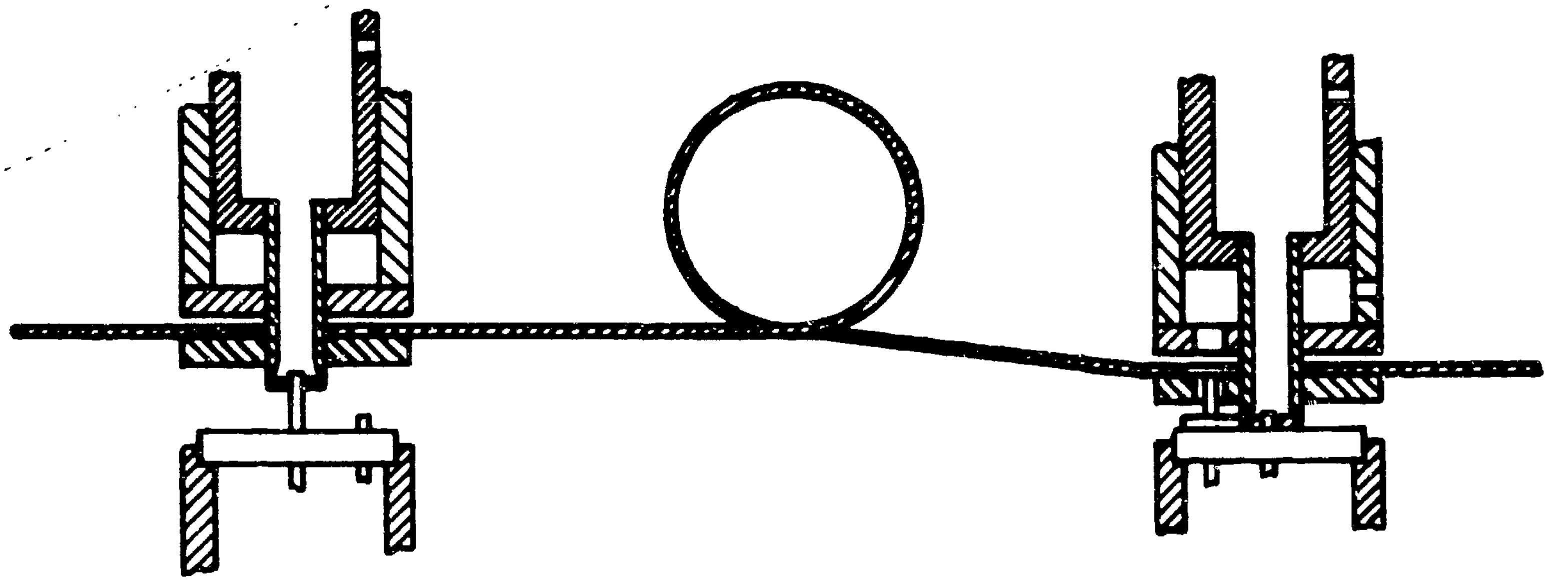


b

DIE HEADS MOVING DOWN

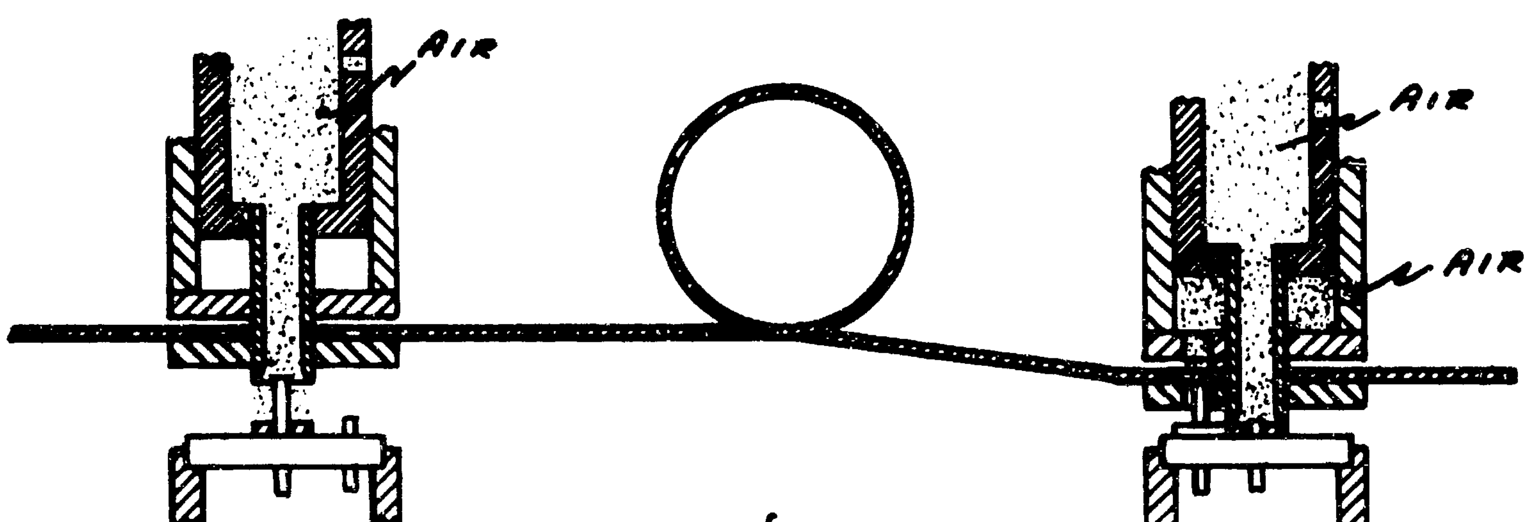
FIG. 2

SCHEMATIC OF COPPER WASHER MACHINE DIE HEAD ACTION
(SHOWING ONLY TWO LEADS)



c

BLANKING OF WASHERS

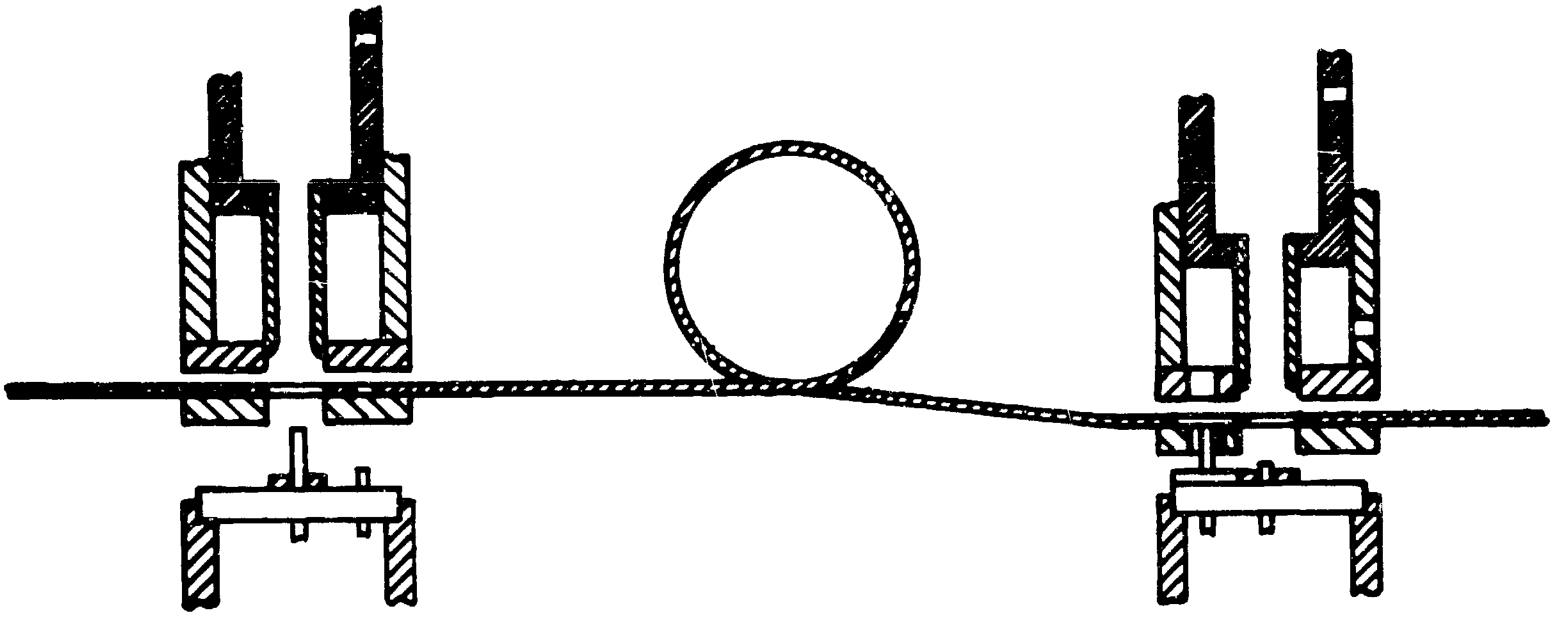


d

WASHERS STRIPPED FROM PUNCHES
BY AIR PRESSURE

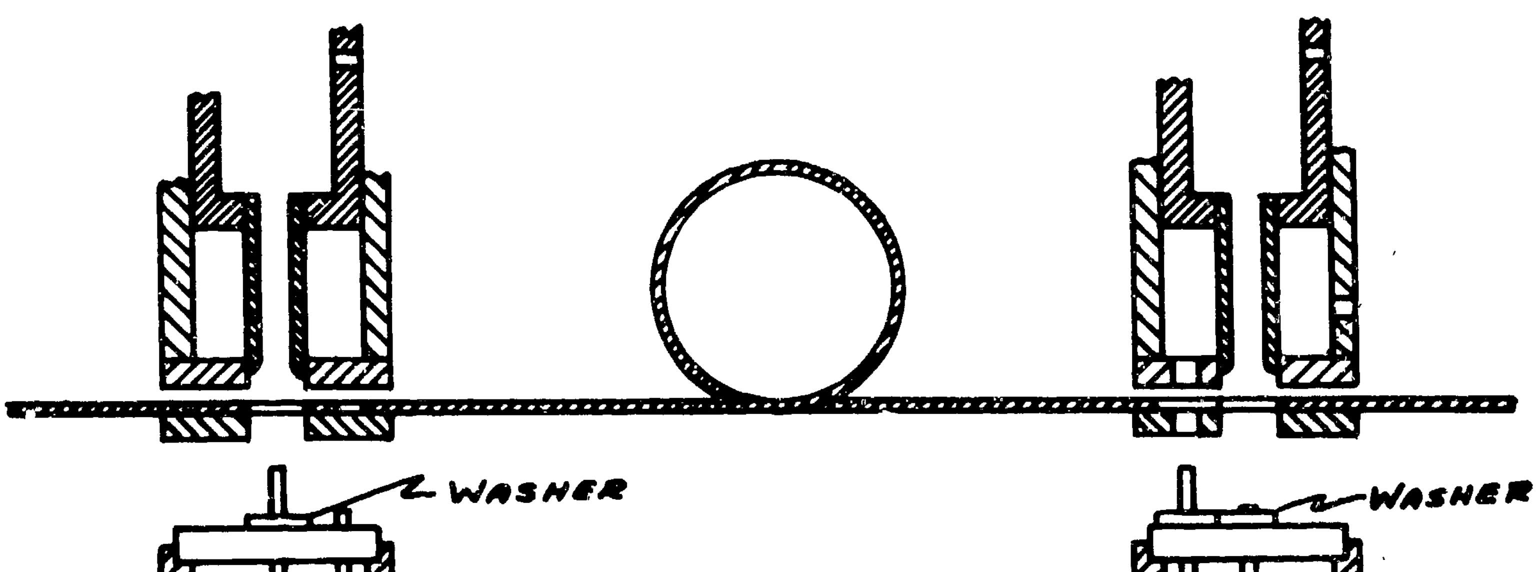
FIG. 3

SCHEMATIC OF COPPER WASHER MACHINE DIE HEAD ACTION
(SHOWING ONLY TWO LEADS)



e

DIE HEADS MOVING UP



f

DIE HEADS UP

FIG. 4

SCHEMATIC OF COPPER WASHER MACHINE DIE HEAD ACTION
(SHOWING ONLY TWO LEADS)

IV. CONCLUSIONS

A. EQUIPMENT STATUS

All equipment, with the exception of the copper washer machine, was in production use during this period and appears capable of fulfilling the requirements of the production run. The copper washer machine continued to be a source of excessive shrinkage due to tilted grid flanges. However, the source of this problem has been related to variations in air pressure, and a new pneumatic supply system is being installed.

B. PREPRODUCTION RUN

Overall preproduction test results indicate compliance with specifications published for tube type 7587. A quality control plan has been submitted which, upon approval, will allow commencement of the production run.

V. PROGRAM FOR NEXT INTERVAL

A. Plans will be made for the production run.

B. Upon approval of preproduction results and the quality control plan, a date will be set for commencement of the run.

C. The production run will be held and the product tested in accordance to plan.

D. Test results will be submitted for approval.

E. The final report, and step II report will be prepared and submitted.

VI. PUBLICATIONS AND REPORTS

Monthly Letter Report:

#15 for November, 1963
#16 for December, 1963
#17 for January, 1964

Description of Test Equipment Used for Qualification testing at Harrison, New Jersey, dated January 8, 1964.

Test Data on 7587 Preproduction Samples.

Inspection and Quality Control Plan on PEM for Tube Type 7587.

VII. IDENTIFICATION OF TECHNICIANS

A. Manpower Effort During 7th Quarter

1. Technical

R. Feyder	200 hrs.
G. Lalak	100 hrs.
B. McPherson	80 hrs.
G. Shaffer	16 hrs.
J. Thompson	22 hrs.
M. Tuttle	85 hrs.

2. Semi-Technical

C. Berman	352 hrs.
S. Clements	11 hrs.
L. Cottino	20 hrs.
M. Davis	11 hrs.
W. Gebrian	62 hrs.
M. Larkin	25 hrs.
D. Moran	8 hrs.
H. Prash	15 hrs.
B. Sherman	44 hrs.