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SLOW SPEED TACHOMETER FOR MEASURING WELD WIRE AND CARRIAGE FEEDS

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NASA

George C. Marshall
Space Flight Center,
Huntsville, Alabama

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ABSTRACT

This document describes a tachometer system designed to measure the rate of weld wire feed and carriage feed to an accuracy of 0.0025 meter (0.1 in.) per minute. The system utilizes a visual display and an analog output for recording deviations in speed.

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MANUFACTURING ENGINEERING LABORATORY
RESEARCH AND DEVELOPMENT OPERATIONS

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SLOW SPEED TACHOMETER FOR MEASURING WELD WIRE AND CARRIAGE FEED

SUMMARY

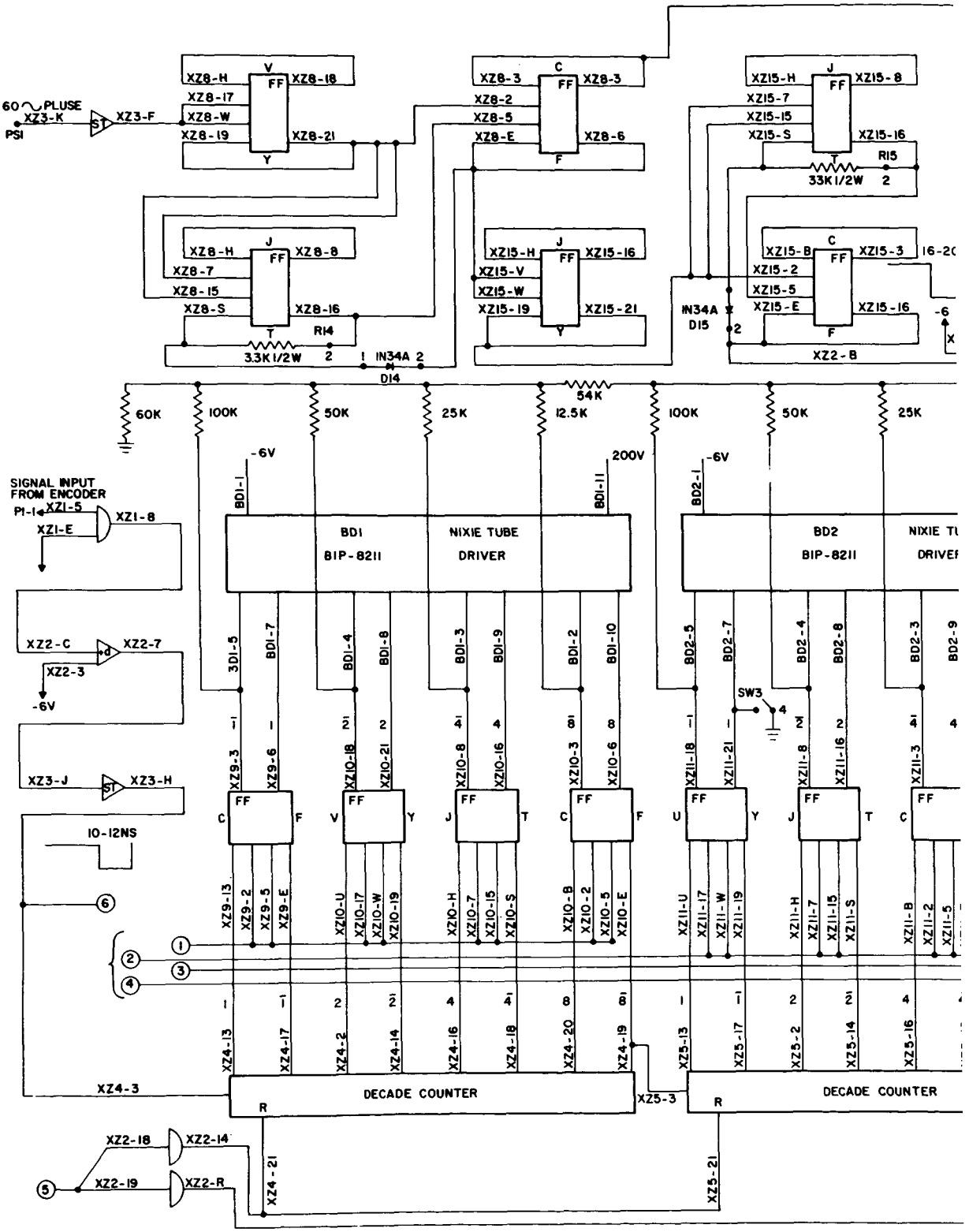
A tachometer system designed to measure the speed of weld-wire feed and carriage feed to an accuracy of 0.0025 meter (0.1 in.) per minute is described. The system employes two methods of read out, a visual display and an analog output for recording any deviation in speed.

INTRODUCTION

One of the problems associated with welding large sections of metal has been the lack of an accurate means of monitoring the speed of the weld-wire feed and the carriage feed. A change in the feed-rate of either of these components will cause a discrepancy in the weld. The major problem in obtaining suitable monitoring equipment is the slow rate of feed and the accuracy desired. To fully cover all welding processes, the monitoring device should operate between 0.25 and 12.7 meters (10 to 500 in.) per minute. There have been several systems designed and used in the past; however, none have worked satisfactorily.

SYSTEM DESCRIPTION

A system (Fig. 1) has been designed and is now in operation that will measure linear motion to an accuracy of $\pm$0.0025 meter ($\pm$0.1 in.) per minute from 0.13 to 12.7 meters (5 to 500 in.) per minute. This was accomplished by utilizing an optical shaft encoder (Fig. 2) that has an output of 4096 pulses per revolution of the shaft. By using a shaft wheel that is 0.104 meter (4.096 in.) in circumference, each output pulse from the encoder represents 0.00003 meter (0.001 in.) linear displacement. These pulses are amplified and fed into a time referenced counter with a binary coded decimal output. The counter reads the pulses for a one-time period and then retains this information in a storage unit.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3.3K1/2W
1
IN34A
D14
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XZ15-V
XZ15-W
XZ15-19
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60K
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50K
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54K
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200V
BD1-1
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SIGNAL INPUT
FROM ENCODER
P1-1
XZ1-5
XZ1-8
XZ1-E
BD1
BIP-8211
NIXIE TUBE
DRIVER
BD2
BIP-8211
XZ2-C
XZ2-7
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-6V
XZ3-J
XZ3-H
10-12NS
SW3
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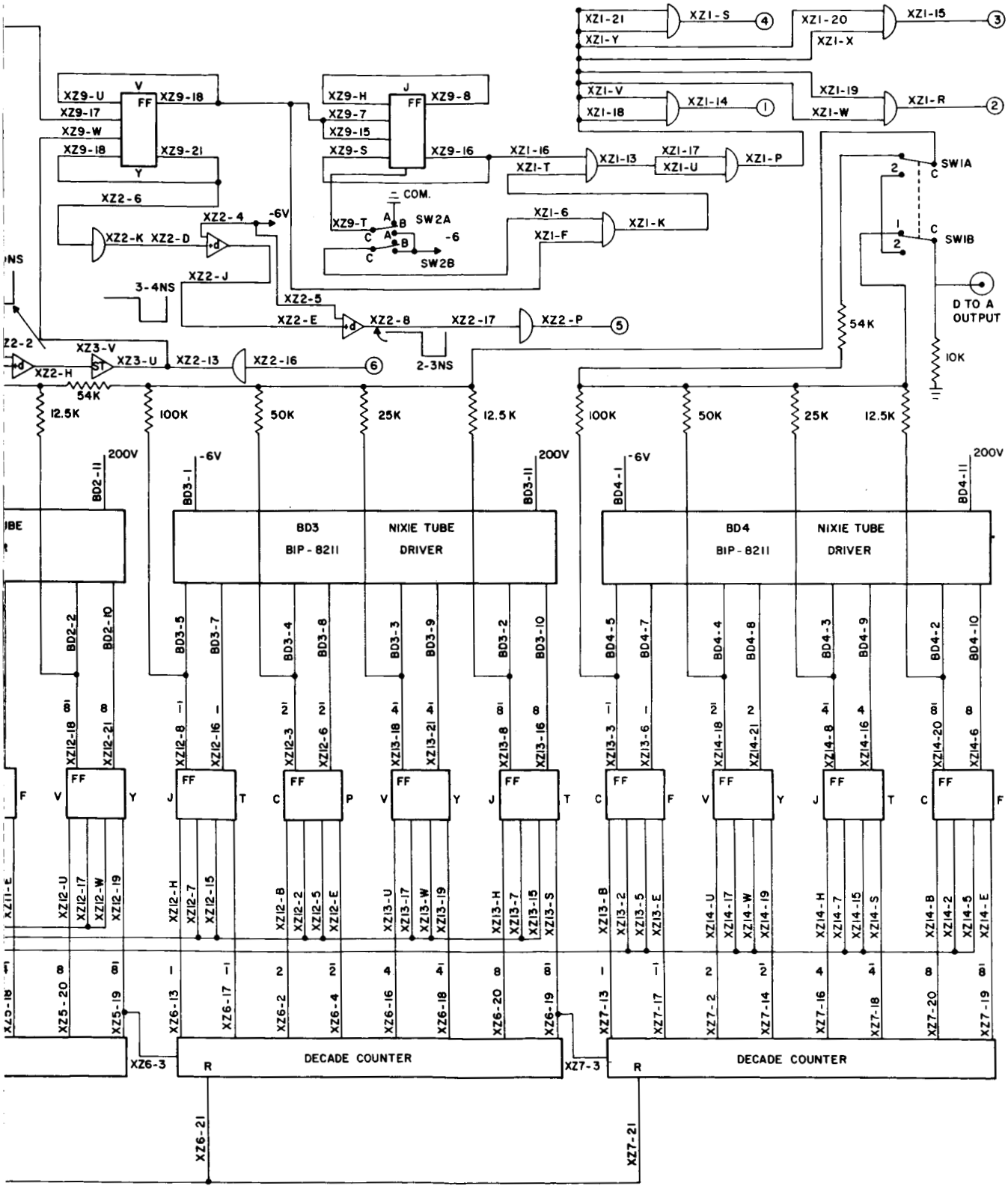
XZ4-20
XZ4-19
XZ5-13
XZ5-17
XZ5-2
XZ5-14
XZ5-16
XZ4-3
DECADE COUNTER
R
XZ25-3
XZ2-18
XZ2-14
XZ2-19
XZ2-R
XZ4-21
XZ5-21

3 FIGURE 1.



SYSTEM SCHEMATIC

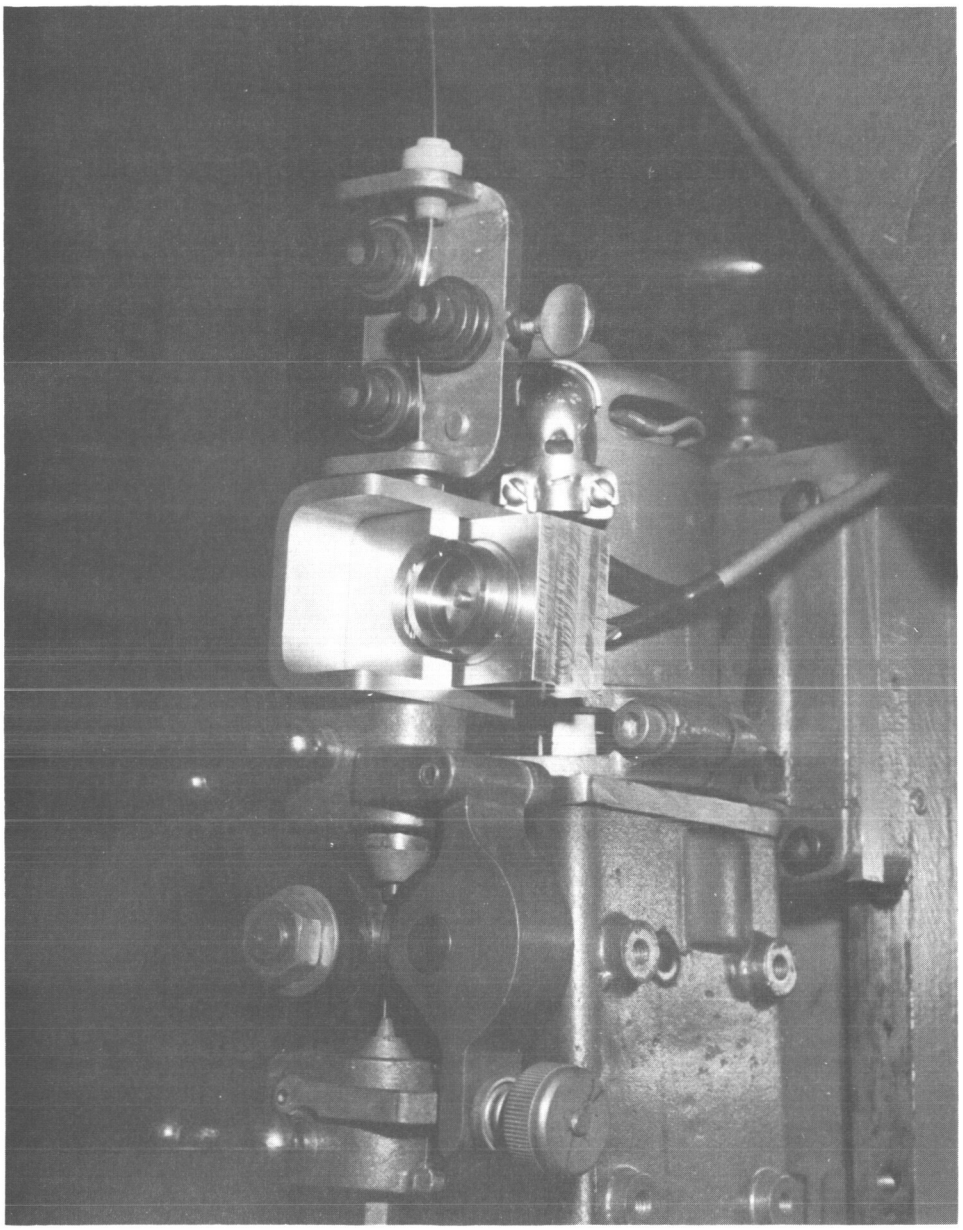


FIGURE 2. MOUNTED WIRE FEED ENCODER

The time reference for the counter is generated from the 60 cycle, 120 volt electrical source. The 60 cycle per second frequency is shaped and counted down to obtain a pulse at 0.6-second intervals. This particular time interval was chosen to obtain an output in inches per minute with an accuracy of $\pm$0.0025 meter ($\pm$0.1 in.) per minute. If the time interval is one minute, for example, the accuracy is 0.00003 meter (0.001 in.) per minute. Because a shorter time-referenced period was necessary, 0.01 minute or 0.6 second was chosen. Each time-reference pulse stops the counter, transfers the information into the storage section, and then resets the counter to zero to began the next count. The circuitry is so designed that any pulse, arriving at the counter input while the transfer of information or the resetting of the counter is in process, will be delayed. After the system has been reset, the delayed pulse is read into the counter.

The counter section consists of four decade counters with binary coded decimal outputs as shown in Figure 3. These outputs are transferred into a

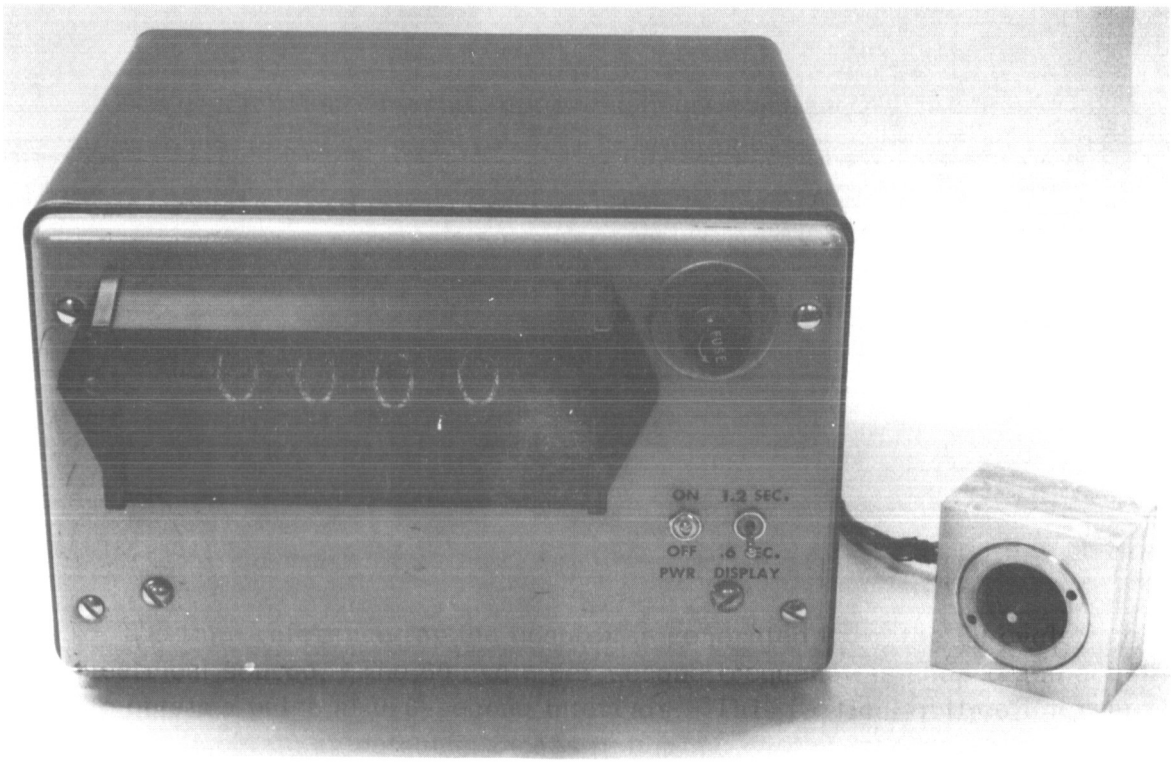


FIGURE 3. COUNTER SECTION VISUAL DISPLAY

storage section with each time-reference pulse. The information in this section is displayed and also fed to a digital-to-analog converter for a one-time interval (0.6 second). The information in the storage section will change only if the rate of rotation of the encoder shaft changes. Therefore, the display and the analog outputs will indicate any rate of change in the linear motion.

The analog section is a resistor ladder network designed to have an output of approximately 2.5 millivolts for each 0.0025 meter (0.1 in.) per minute or 0.025 meter (1.0 in.) per minute of linear motion. Either output may be selected with a sensitivity switch. This section indicates only the change in linear motion. The display will be noted and the analog recorder set to zero. Then, any change from the noted display will be indicated on the analog recording. However, if no record is desired, the visual display will indicate in inches per minute to 0.0025 meter (0.1 in.) per minute the rate of linear travel of the material being checked.

George C. Marshall Space Flight Center,
National Aeronautics and Space Administration,
Huntsville, Alabama, June 9, 1967.

SLOW SPEED TACHOMETER FOR MEASURING WELD WIRE AND CARRIAGE FEEDS

By Experimental Electronic Branch

The information in this report has been reviewed for security classification. Review of any information concerning Department of Defense or Atomic Energy Commission programs has been made by the MSFC Security Classification Officer. This report, in its entirety, has been determined to be unclassified.

This report has also be reviewed and approved for technical accuracy.

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