

1403-2 PRINTER

Dependance of Contact Time on  
Hammer Length and Configuration  
and Impacted Medium

by T. R. Hayes  
J. E. Drejza

Object:

Determine the dependence of contact time on print hammer length and configuration and impacted medium.

Description  
of  
Test

In impact printing, contact time is defined as the duration of a compressive force at the hammer-Ribbon Interface. Our investigation was confined to the three parameters listed above. These parameters were varied over a range limited by practical printer considerations.

A standard IEM-2 Armature Yoke and Coil Assembly was used as the transducer to drive the test hammers. The electrical input to the working air gap, the spring load and hammer mass were held constant throughout the tests. Holding these parameters constant resulted in all three test hammers having the same terminal velocity and therefore equal Kinetic energy. A plate robot was designed which allowed the interchange of three different print hammers in front of our standardized driver.

A 1403-2 hammer two inches long, weighing 2.258 grams was used as a standard of comparison. To determine the influence of hammer length on contact time a one inch long hammer weighing 2.240 grams was tested. Then to check if lumping the mass, as in the 1403-2 Hammer, has an appreciable influence on contact time a two inch long hammer of uniform section and a 2.26 grams in weight was tested. Figure IV shows the robot and the three test hammers.

To investigate a practical range of impacted medium all three hammers were tested with one, three and six part forms (Moore 1413). In each case a .005 inch thick ribbon was in place between the forms and print hammer.

RESULTS

As shown on the attached photographs of print force vs. time Figures I & II, all three hammers have essentially the same contact duration when impacting the same medium. Changes in the contact duration were evident when the impacted medium was varied. Contact durations were 89 to 100 micro-seconds with one part form and ribbon, 140 to 160 micro-seconds with three part form and ribbon, and 190 to 200<sup>+</sup> with six part form of ribbon. The range of results for any given condition is due largely to the difficulty in picking, accurately, the time the compressive force goes to zero at the interface.

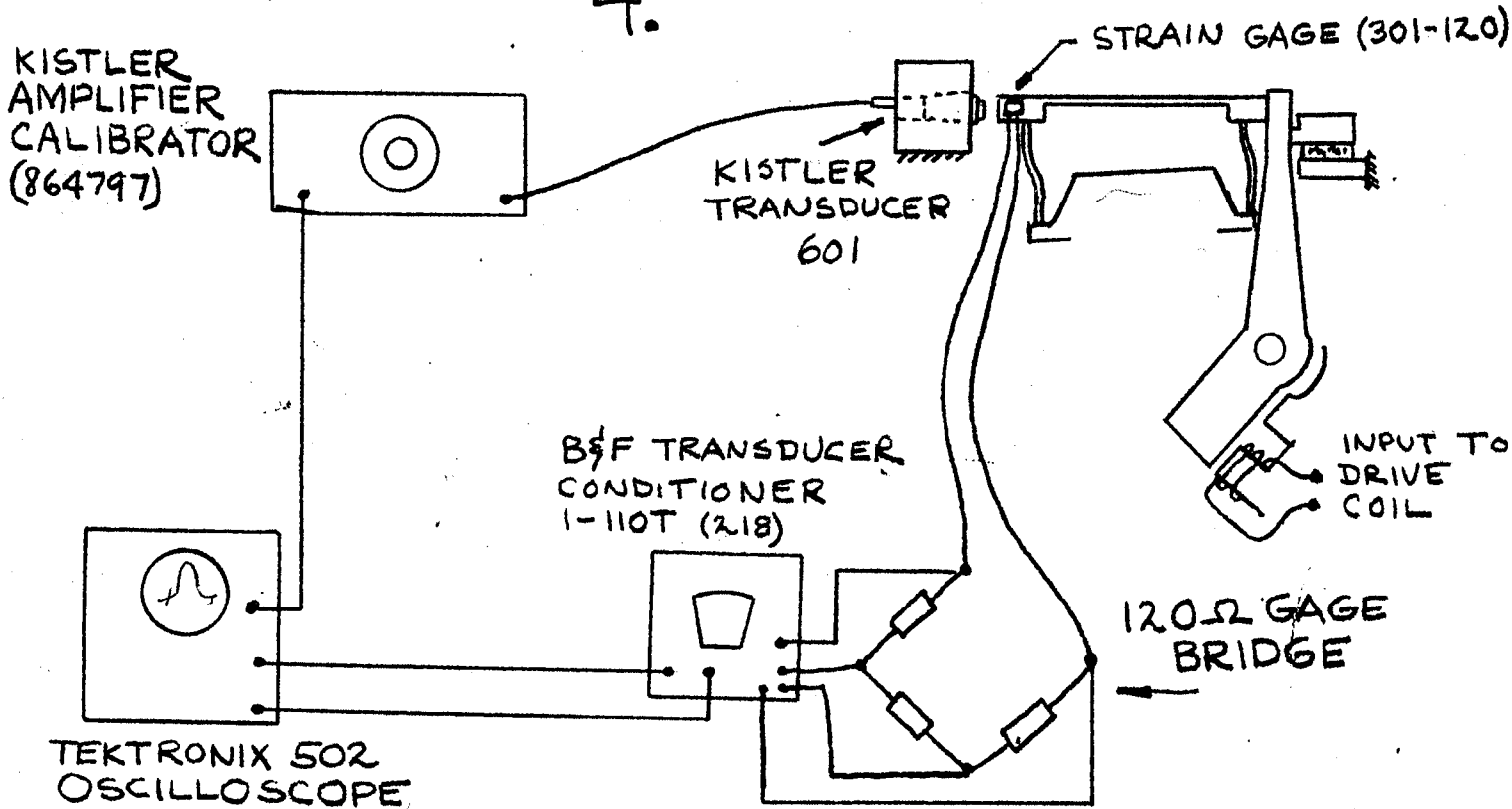
These results show that the paper is the controlling factor and length and hammer configuration have an insignificant effect on contact time in an impact printer. This conclusion is valid for variations in length and configuration consistent with impact printer requirements.

Between impacts the time scale trigger delay was adjusted so the traces could be clearly distinguished. The first trace on the left represents the first impact, the second trace represents the second impact, in the same location, and so on up to five impacts in one location.

Secondly:

The 1403-2 impression control was not in place during our tests; As a check in its influence on contact time we ran one series of tests with the impression control in position. This feature does not radically influence contact time. The times are of the same order of magnitude but exhibit an increase of approximately 20 microseconds. See Figure III.

4.



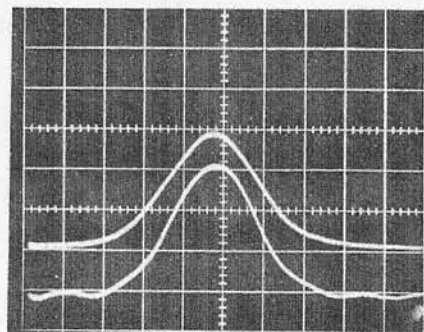
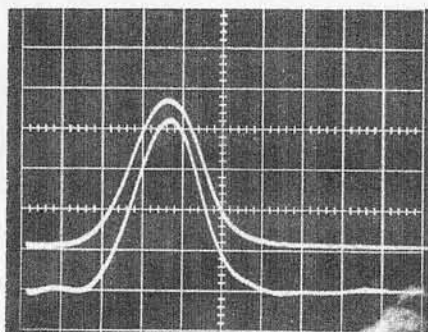
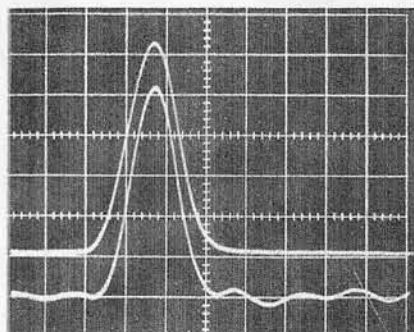
Our experimental set up consisted of a Kistler pressure transducer, a semi-conductor strain gage bonded to the 1403-2 hammer, a current shunt and volt meter to monitor coil input.

To insure that our robot allowed us to make measurements which would be meaningful when related to back printers such as the IBM 1403-2, we bonded a strain gage to the 1403-2 Print Hammer. This hammer was then operated with a 1403-2 Chain Printer Cartridge in place of the Kistler pressure transducer. Then the output of our gage was recorded. Next we removed the cartridge and inserted the Kistler pressure transducer. Now both outputs were recorded and compared to the gage output.

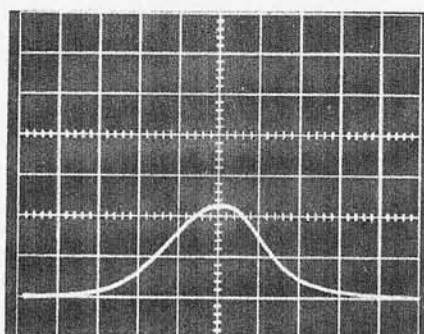
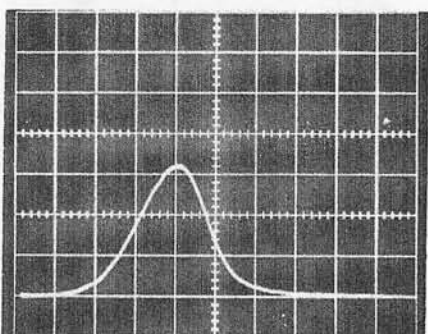
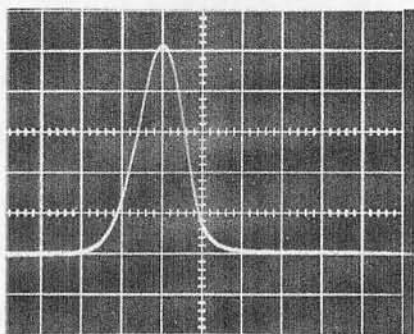
This comparison satisfied us that the robot with the Kistler in place was a good model of a printer. In any case, the influence of the parameters we varied could be ascertained from our data since each successive test was conducted under identical conditions with the Kistler in place.

Two other points of interest should be mentioned since they would influence the results of investigators who were not aware of them.

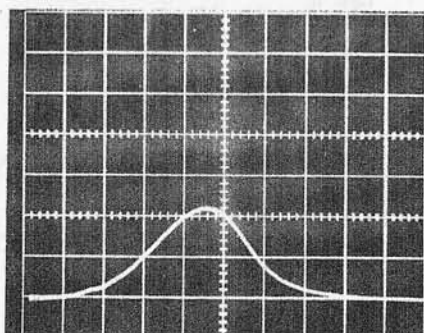
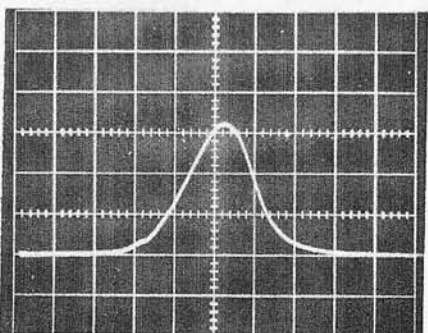
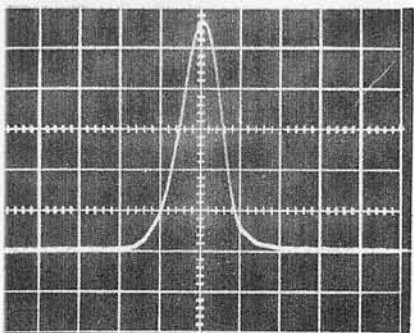
First: All force time relations must be established with only one impact on any segment of the mediam. This necessitates moving the forms between impacts. If this is not done successive impacts in the same location result in higher peak loads and shorter contact times. This change continues for at least the first five impacts in one spot. Figure III shows force time relation for one part form amd ribbon, and three part form and ribbon.



**1403-2 HAMMER**  
 (WITHOUT IMPRESSION CONTROL)  
 UPPER TRACE-KISSLER TRANSDUCER  
 HORIZ.-20 MICRO SEC/ CM  
 VERT.- 10 LB/ CM  
 LOWER TRACE-STRAIN GAGE  
 HORIZ.-20 MICRO SEC/ CM  
 VERT.- 8.4 LB/ CM



**2 INCH HAMMER LENGTH**  
 HORIZ.-20 MICRO SEC/ CM  
 VERT.- 10 LB/ CM



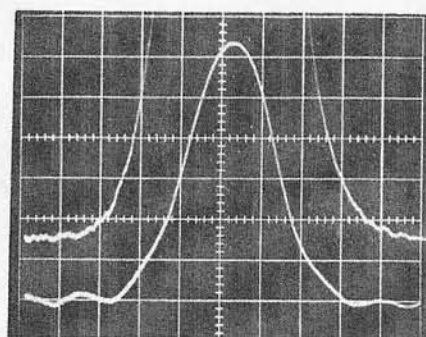
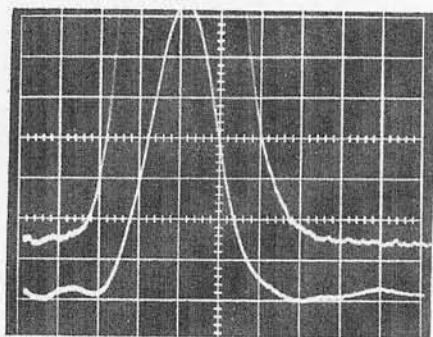
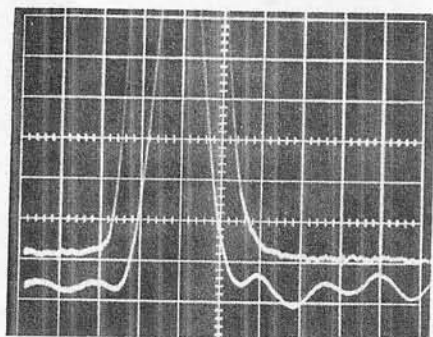
**1 INCH HAMMER LENGTH**  
 HORIZ.-20 MICRO SEC/ CM  
 VERT.- 10 LB/ CM

1 PART FORM  
 AND RIBBON

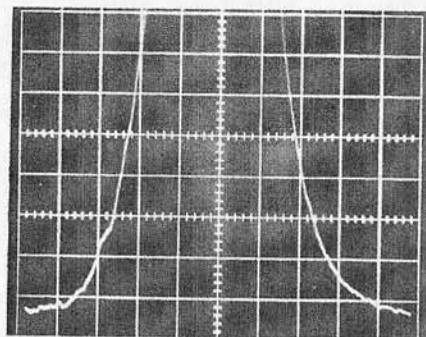
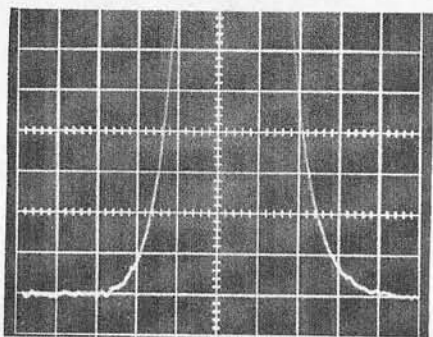
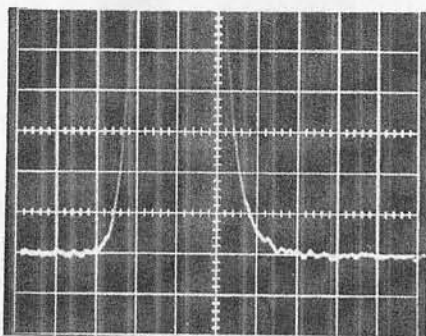
3 PART FORM  
 AND RIBBON

6 PART FORM  
 AND RIBBON

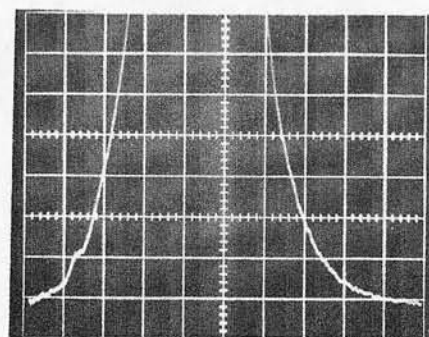
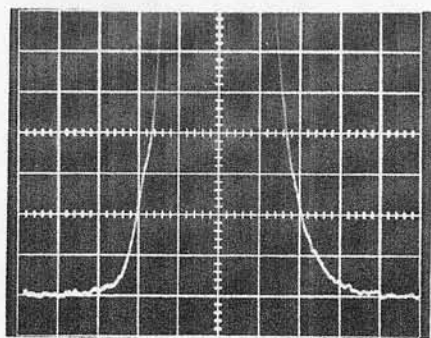
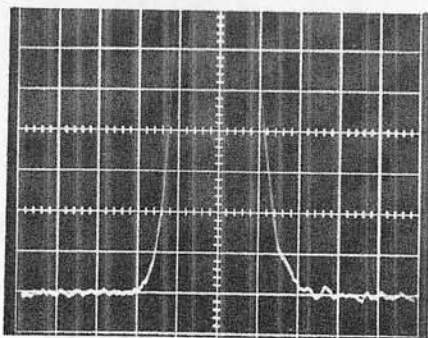
**FIGURE I**



**1403-2 HAMMER**  
 (WITHOUT IMPRESSION CONTROL)  
 UPPER TRACE-KISSLER TRANSDUCE  
 HORIZ.- 20 MICRO SEC / CM  
 VERT.- 1 LB / CM  
 LOWER TRACE  
 HORIZ.- 20 MICRO SEC / CM  
 VERT.- 4.2 LB / CM



**2 INCH HAMMER  
 LENGTH**  
 HORIZ.- 20 MICRO SEC / CM  
 VERT.- 1 LB / CM



**1 INCH HAMMER  
 LENGTH**  
 HORIZ.- 20 MICRO SEC / CM  
 VERT.- 1 LB / CM

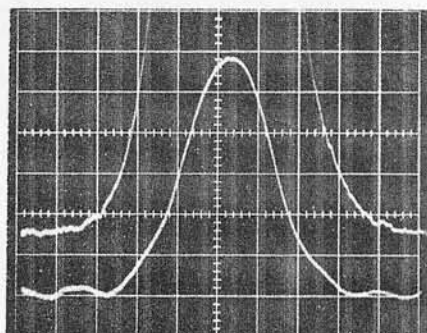
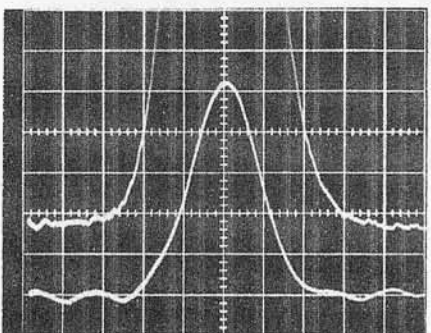
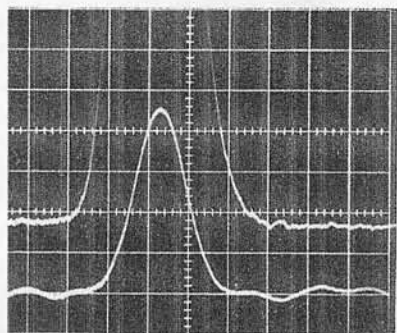
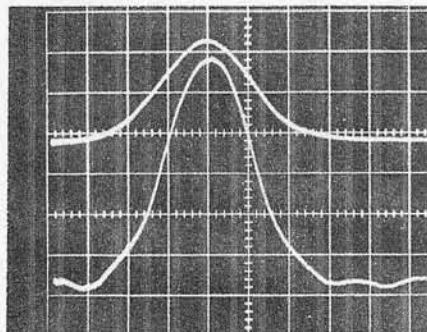
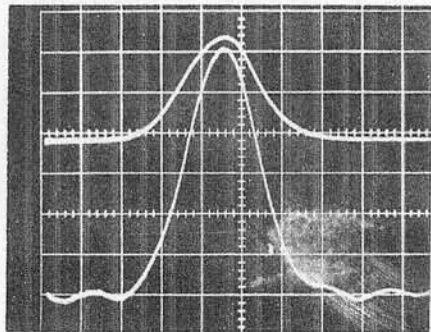
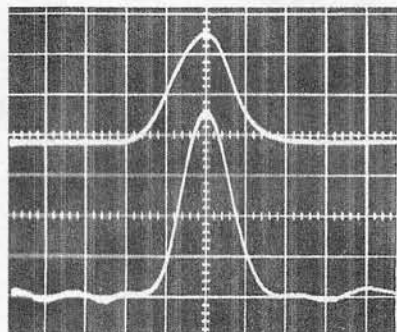
1 PART FORM  
 AND RIBBON

3 PART FORM  
 AND RIBBON

6 PART FORM  
 AND RIBBON

**FIGURE II**



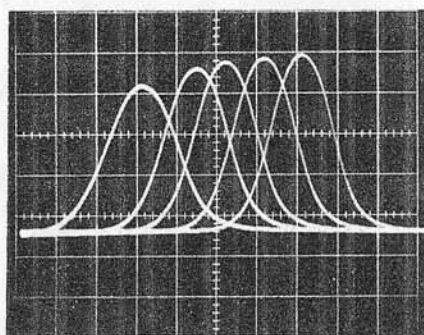
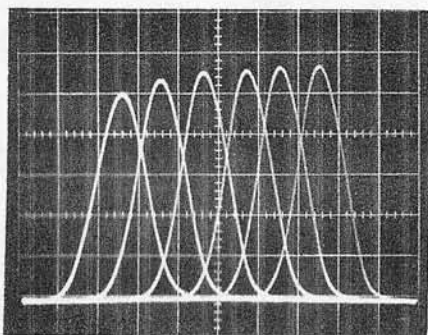


1 PART FORM  
AND RIBBON

3 PART FORM  
AND RIBBON

6 PART FORM  
AND RIBBON

EFFECT OF SEVERAL  
HITS OF HAMMER  
AT SAME PLACE  
ON FORM



1 PART FORM  
AND RIBBON

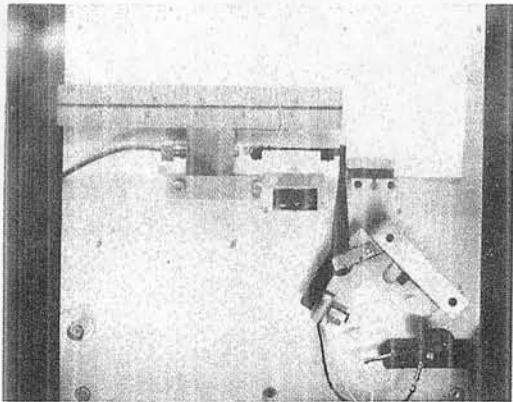
3 PART FORM  
AND RIBBON

# 1403-2 HAMMER

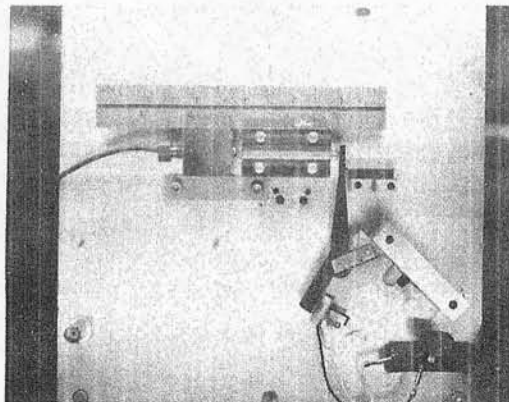
(WITH IMPRESSION CONTROL)  
UPPER TRACE-KISSLER TRANSDUCER  
HORIZ.-20 MICRO SEC / CM  
VERT.- 10 LB / CM  
LOWER TRACE-STRAIN GAGE  
HORIZ.- 20 MICRO SEC / CM  
VERT.- 4.2 LB / CM

SAME AS ABOVE . BUT  
UPPER TRACE VERT. SCALE  
IS 1 LB / CM

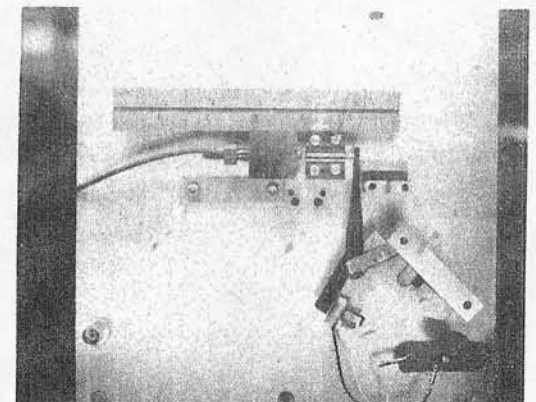
## FIGURE III



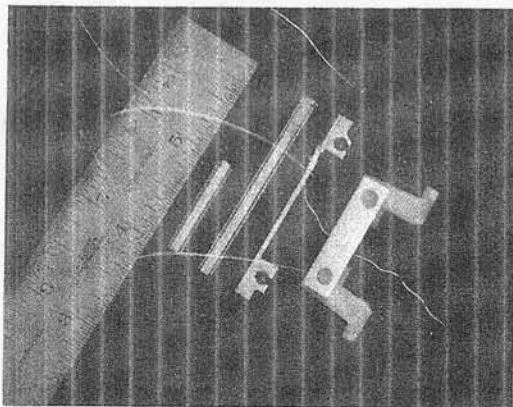
ROBOT WITH 1403-2 HAMMER



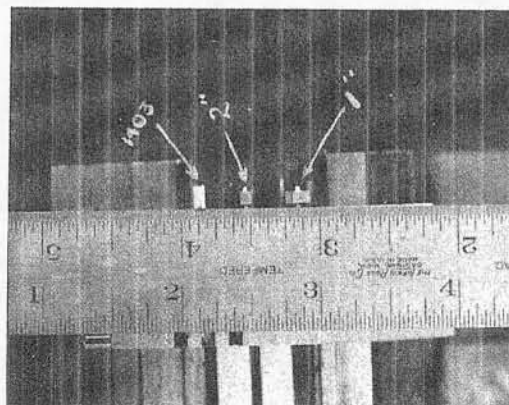
ROBOT WITH 2 INCH HAMMER



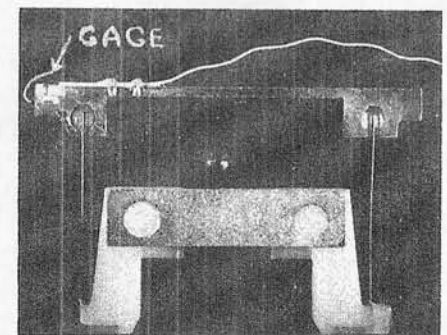
ROBOT WITH 1 INCH HAMMER



SIDE VIEW OF HAMMER



END VIEW OF HAMMER



STRAIN GAGE ON 1403-2  
HAMMER

FIGURE IV