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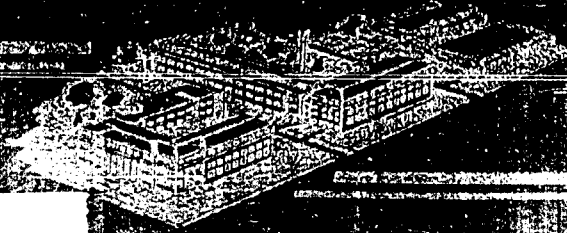
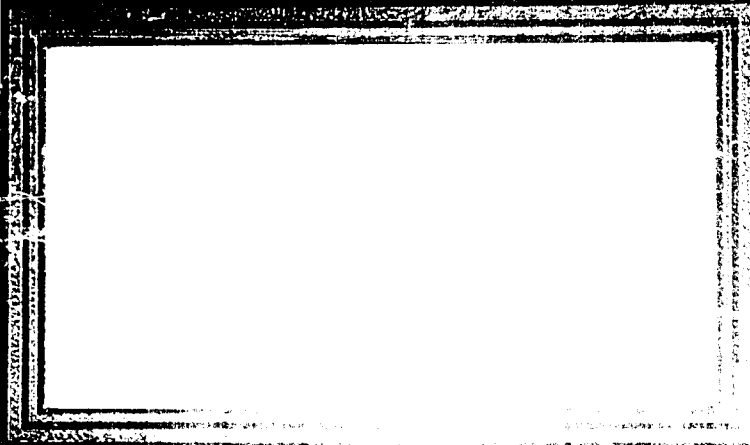
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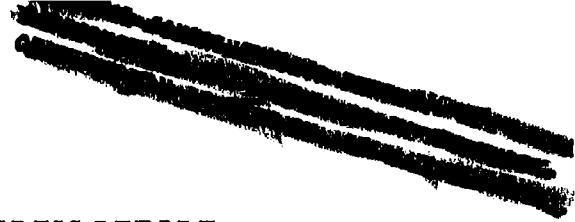


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Feb 10 1953



SEVENTH MONTHLY PROGRESS REPORT

on

A STUDY AND EVALUATION OF LIQUID-  
LEVEL AND LIQUID-VOLUME CONTROLS  
FOR SHELL-, ROCKET-, AND BOMB-  
FILLING MACHINES

to

ARMY CHEMICAL CENTER

January 30, 1953

Contract No. DA 18-108-CML-3965

by

Thomas M. Boland, William Hecox,  
Roger L. Merrill, and Robert C. McMaster

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January 30, 1953

Commanding General  
Chemical Corps Chemical and  
Radiological Laboratories  
Army Chemical Center, Maryland

Attention Mr. Curt Hesdoerffer  
Project Officer

Dear Sir:

We are enclosing six copies of the Seventh Monthly Progress Report on "A Study and Evaluation of Liquid-Level and Liquid-Volume Controls for Shell-, Rocket-, and Bomb-Filling Machines", covering the period of January 2, 1953, to January 30, 1953.

During this month, the sequencing circuit for the volume-filling device was designed and built. Also, an initial design for a release valve was constructed.

Late delivery of additional parts for the Annin valve prevented additional work on the entire operation of the filling system. Improvements were effected on the servomotor drive mechanism, providing more reliable valve operation.

Yours very truly,



Thomas M. Boland  
Electrical Engineering Division

TMB:bep  
Enc. (6)

R E S E A R C H   F O R   I N D U S T R Y

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SUMMARY

↓ The sequencing control equipment has been constructed and installed in the constant-volume munition-filling device. This circuit provides automatic control of the entire filling-operation cycle.

The servomotor drive that operates the Annin valve was modified, and its performance improved. The servomotor, gearbox, and rate generator have been mounted into a compact unit, providing precision operation and sturdy construction.

Late delivery of Annin valve seats and plugs have delayed further tests of the entire munition-filling system. A preliminary model of the release valve for the weigh chamber was built; however, certain design improvements are necessary on this device.

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## INTRODUCTION

This is the Seventh Monthly Progress Report on "A Study and Evaluation of Liquid-Level and Liquid-Volume Controls for Shell-, Rocket-, and Bomb-Filling Machines". This report covers the period from January 2, 1953, to January 30, 1953.

A basic filling system to dispatch accurately repeatable volumes of liquid agent into munitions has been constructed at Battelle. Initial tests of this showed overfilling resulted, and modifications to the system to attain accuracy are now being made.

## WORK IN PROGRESS

The work in progress during January was comprised of the following:

1. Design and construction of the sequencing circuit.
2. Design and construction of a basic release valve.
3. Improve the alignment of the servomotor drive.

## Sequencing Circuit

The circuit that will provide automatic sequencing for the various phases of the filling operation has been designed and built. The circuit diagram is shown in Figure 1, and a photo of the built-up unit in Figure 2.

Operation of the sequencing is fully automatic, once the filling system is started. The initial conditions of the circuit when the weigh chamber is empty are:

1. Relay R is energized.
2. The microswitches are such that Switch 1 is open, Switch 2 is open, and Switch 3 is closed.

As the chamber fills and scale balances, the voltage across the scale differential transformer decreases. The voltage to Relay Coil R also decreases, and when balance is reached, R drops out.



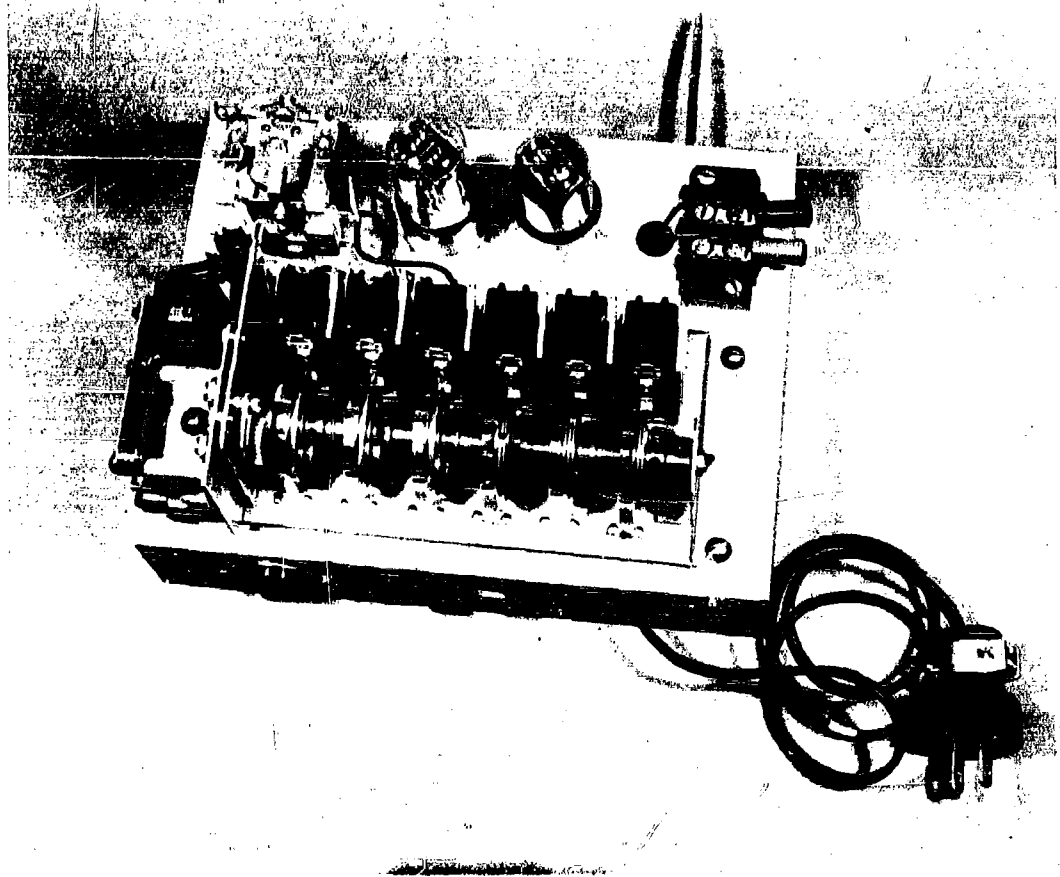


FIGURE 2. AUTOMATIC SEQUENCE-CONTROL MECHANISM

This starts the microswitch shaft motor and opens the input circuit to the servo amplifier. After this motor runs one second, it is locked in through Microswitch 1, and Microswitch 3 opens, keeping the servo-amplifier input open.

After the motor runs two seconds, Microswitch 2 closes, and the release valve opens.

The motor cycle is such that ample time is provided for emptying the weigh chamber.

As the chamber empties, the scale differential-transformer voltage rises, and Relay R is energized. The input to the servo amplifier is kept open by Microswitch 3, preventing filling.

When the time period for emptying is over, Microswitch 2 opens, and the valve closes. One second later, Microswitch 1 opens and 3 closes. This stops the shaft motor and connects the differential-transformer output to the servo amplifier. Another filling operation then follows.

A bank of six microswitches has been included in this unit. Only three are used in the present circuit.

#### Release Valve

A solenoid-operated valve for releasing the contents of the weigh chamber has also been built. It is pictured in Figure 3.

Construction is such that the coil is completely enclosed and, therefore, moistureproof. The seal at the plug is provided by an O-ring wedged in a tapered hole.

This valve is open only when energized, providing protection against voltage failure.

This valve represents the initial design for a release device. Its operation is not entirely satisfactory, and improvements will be made in the future.

#### Improvement of Servomotor Drive

Figure 4, picturing the present laboratory model of the weigh filling system, discloses the mounting constructed for the valve-operating mechanism. It is positioned directly above the Annin valve and weigh chamber (as shown).

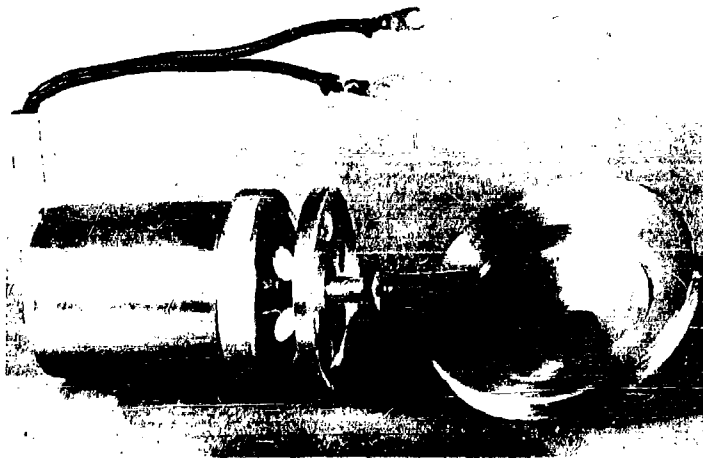
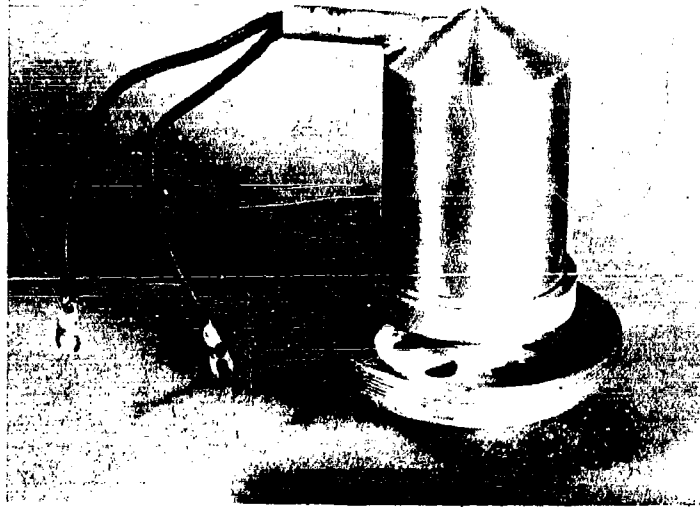
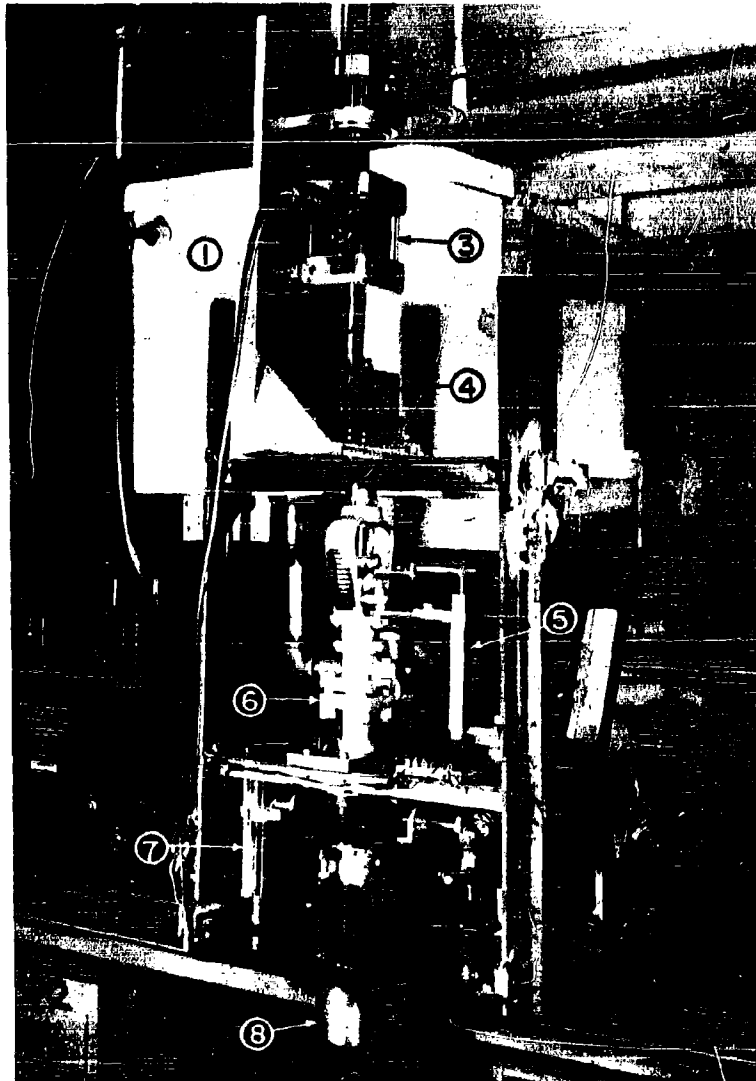


FIGURE 3. WEIGH-CHAMBER RELEASE VALVE

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- |                   |                                   |
|-------------------|-----------------------------------|
| 1. Supply tank    | 5. Valve differential transformer |
| 2. Rate generator | 6. Annin valve                    |
| 3. Servomotor     | 7. Scale differential transformer |
| 4. Speed reducer  | 8. Weigh chamber                  |

FIGURE 4. VIEW OF CONSTANT-VOLUME FILLING DEVICE SHOWING ANNIN VALVE AND SERVO MOTOR DRIVE

The servomotor, gear box, and rate generator are fastened to this mounting providing a compact, precision device.

During the preliminary tests of the basic system, two properties of the valve-operating mechanism were found to be desirable. These are:

1. A well-aligned drive shaft and gear mechanism between the motor and the valve.
2. Rugged construction of the motor and gear mountings to insure permanent alignment.

The first of these is desired because the output torque of the present servomotor is not very much larger than that required to operate the valve. With minimum losses due to coupling to the valve, however, it is hoped that satisfactory performance will be achieved. If not, a larger servomotor and gear unit will be incorporated into the filling system.

Delivery of the additional valve plugs and seats for the Annin valve have delayed further work on the entire filling system. These parts are expected to arrive at Battelle in the near future.

#### FUTURE WORK

The immediate future effort will be directed toward:

1. Improving the chamber release valve.
2. Finding a suitable combination of valve parts and other control items which will achieve accurate weigh filling.

TMB:WH:RLM:RCM/bep  
January 27, 1953

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