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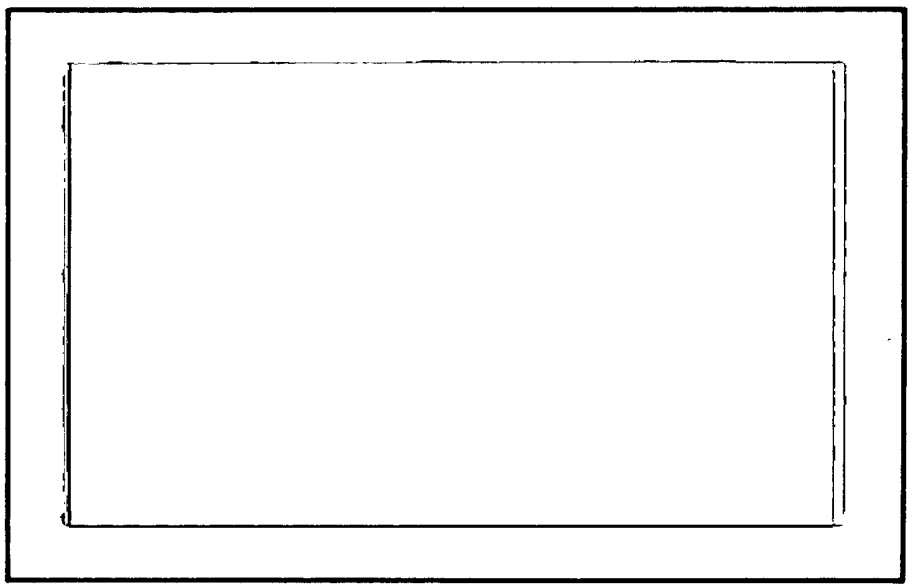

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Final Report

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January 16, 1962

Dear Sir:

Enclosed is the "Summary Report on Task Order No. SS", which describes the research performed from March 4, 1960, through March 4, 1961. Other closely related research performed under Task Order No. TT, Work Order No. 9, is also discussed in this report.

The report describes the experimental work done during the development of a miniature-size experimental incinerator identified as the Model 3 incinerator. The unit developed under this program performed satisfactorily and is the basis for the production units which you are planning.

We have enjoyed working on your incinerator program and are looking forward to receiving comments which you may get from your associates on the use of these incinerators under field conditions. If you have any questions with regard to this report, please do not hesitate to call on us.

Sincerely,

[redacted]

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In Triplicate

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CONFIDENTIAL

SUMMARY REPORT

ON

TASK ORDER NO. 58

March 4, 1961

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SUMMARY REPORT

ON

TASK ORDER NO. SS

March 4, 1961

INTRODUCTION

Emergency destruction of security-classified papers and documents in an especially designed incinerator was demonstrated previously in the Model 1 Air-Fed Incinerator, which was developed under Task Order No. Z. Later, starting in December, 1959, a reduced-size incinerator (subsequently identified as the Model 2 Air-Fed Incinerator) was being evolved under Task Order No. RR when it appeared that a still smaller unit, referred to as the miniature-size incinerator, would also be needed for the routine daily destruction of much smaller quantities of paper. This miniature-size unit was subsequently designated as the Model 3 Air-Fed Incinerator.

The development of the Model 2 unit had been regarded as a rather straightforward scale down of the earlier and larger Model 1 unit. However, new concepts were believed necessary for the development of the Model 3 unit, because of its small size and the additional requirements of a greater degree of destruction and further reduced emission of fly ash.

Note: Data upon which this report is based may be found in Laboratory Record Books No. 16828, pp 1-100; No. 17174, pp 1-100; No. 17293, pp 1-100; No. 17492, pp 1-100; and No. 17692, pp 1-17.

Thus, Task Order No. 8S was set up, with the objective of developing an experimental miniature-size incinerator which would incorporate the principles of the air-cooled, metal liner and of combustion by means of relatively high-velocity air jets. The effort was directed toward satisfying several specific requirements; the unit of interest was to incorporate and/or provide the following characteristics and/or capabilities:

(1) A compact, lightweight, top-loading, attractive unit.

(2) Reliable and simple in operation; initial ignition with a match, and no need for auxiliary fuel.

(3) The ability to burn from four to seven bags (25-lb-bag size) filled with crumpled paper, or the equivalent amount of whole or torn sheets during an 8-hr day.

(4) Minimum emission of fly ash, smoke, and tiny flakes of charred paper.

(5) Complete destruction.

(6) Relatively low operating-noise level.

This report summarizes the above-outlined research, which was conducted under Task Order No. 8S during the period from March 4, 1960, through March 4, 1961.

SUMMARY

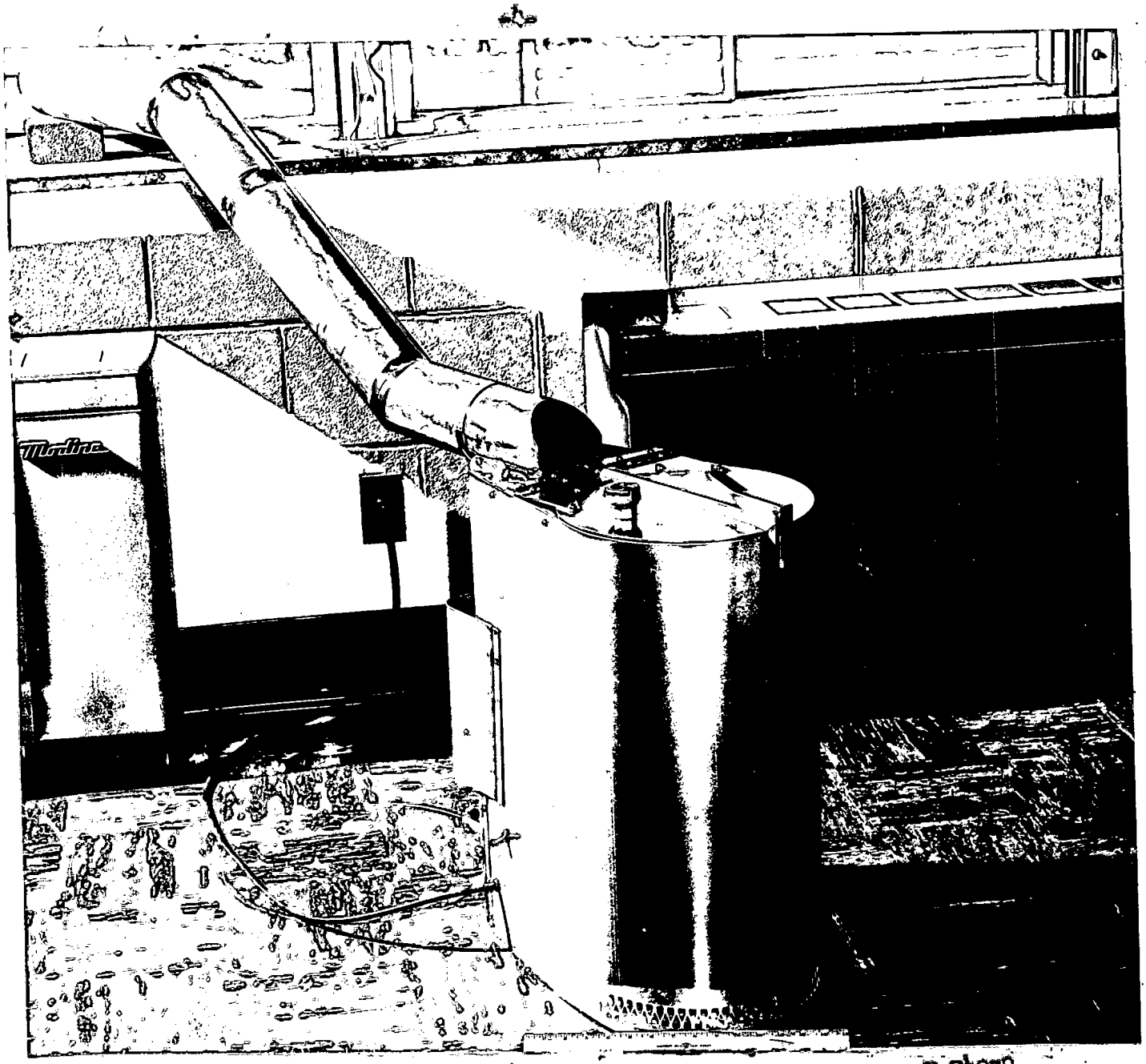
Considerable research involving nearly 400 exploratory burning experiments was performed in simple laboratory equipment, to establish design

parameters. As a result, an experimental, miniature-size, Model 3, paper-burning incinerator was developed that met the objectives of the Task Order No. 8S program.

Figure 1 shows the experimental Model 3 unit and presents a tabulation of its major features. The quantity of paper that can be burned in one batch may be varied up to 2 lb of torn, stacked sheets, or up to 1/2 lb of crumpled sheets contained in a paper bag. If larger quantities of stacked sheets are burned per batch, good burnout of the residue is not obtained. To operate the Model 3 unit, a bag of paper or the equivalent is loaded, the paper is ignited with a match, the door is closed, and the blower is immediately turned on. In 10 to 25 min, depending on the quantity and type of paper charged, the paper is destroyed; the progress of the incineration can be checked visually through the sight port.

Although exhaustive tests were not conducted, preliminary evaluation during 12 tests showed virtually no emission of smoke and fly ash during the greater part of each operating period. Near the end of each burning operation, a slight visible haze (of dust) appeared. No unburned, legible paper was found in the combustion chamber or in the ash container after operation. Some ash and pieces of fragile char were left as residue in the combustion chamber; the char was easily broken up and made illegible by using a small hand poker. The ash container was provided with sufficient capacity to hold the collected material from the burning of several batches of paper.

Outside surface temperatures of the unit during operation were low enough that the unit can be safely used in an office. However, the stack was



(1)	Quantity of paper in one batch	2 lb maximum
(2)	Time to burn one batch of paper	10 to 25 min
(3)	Over-all height of unit including flue connection	27 in.
(4)	Width of unit	12 in.
(5)	Depth of unit	20 in.
(6)	Weight of unit (excluding flue pipe)	85 lb
(7)	Diameter of flue pipe	4 in.
(8)	Diameter of feed opening at top of combustion chamber	10 in.
(9)	Electric power	700 watts, 115 volts, single phase, 50 or 60 cycles
(10)	No auxiliary fuel required; paper ignited with a match	
(11)	Finish, gray [illegible]loid enamel.	

Figure 1. Model 3, Miniature-Size Incinerator

hotter; during operation, care should be taken not to touch the stack. The operating noise level of the unit was considerably lower than that of a household vacuum cleaner which uses the same type of blower.

A field evaluation conducted by the Sponsor demonstrated that the performance of the unit was generally satisfactory. In preparation for the manufacture of several Model 3 units, the Sponsor arranged with a commercial fabricator to furnish shop drawings and to build the first production unit. Under Task Order No. TT, Work Order No. 9, we furnished technical advisory services during such preparations for production. We anticipate further similar activity in connection with the fabrication and acceptance testing, of additional units, and with the preparation of an instruction manual for the Model 3 incinerator.

EXPLORATORY EXPERIMENTS

The miniature-size incinerator represented such a large step downward in size as compared to the Model 1 incinerator, that it was doubtful, initially, that a simple scaling down would satisfy the requirements laid down for a Model 3 unit. Consequently, the first phase of the Task Order No. 88 research program was directed toward conducting some rather broad exploratory experiments in simple equipment, in order to obtain data for the design of the major components of a miniature-size incinerator. Specifically, data were needed to provide a basis for the design of a small combustion chamber and for the selection of a suitable blower, and to give an early evaluation of the nature and extent of the fly-ash emission.

The initial specification for the quantity of paper to be burned in a single-batch operation was 1/2 lb of either crumpled or torn, stacked sheets

in loose form or contained in a typical classified-waste bag (25-lb-bag size).

For these preliminary experiments, a simple burner consisting of a combustion-chamber liner (12-in. ID and 15 in. in height) was constructed from 16-gage mild steel, and a 15-gal drum served as the shell and air plenum. Air was supplied by an available oversized motor-blower unit. Various arrangements of air ports and louvers were used to provide different air-flow rates and air-jet velocities in burning experiments with crumpled paper in bags and with loose sheets of paper.

Figure 2 is a photograph of the simple laboratory burner used. The exploratory experiments are described in the following.

Non-Turbulent Combustion

In the exploration of non-turbulent combustion, the objective was to provide gentle introduction of combustion air around the paper and thus minimize the lifting of paper, char, or ash from the combustion bed. This was expected to reduce the emission of particulate matter and to simplify the collection of fly ash. A number of chamber configurations, air-port arrangements, and air-flow rates were tried in the simple laboratory burner in connection with the burning of (1) single 1/2-lb batches of crumpled paper of various kinds held in a paper bag as well as loose, and (2) a few single 1/2-lb batches of torn or quartered sheets of paper. A total of 93 test "burns" were run to evaluate the many possible arrangements for the non-turbulent mode of operation.

Early in this study, it was found that air-film cooling was not needed for the miniature-sized combustion chamber; the total heat released

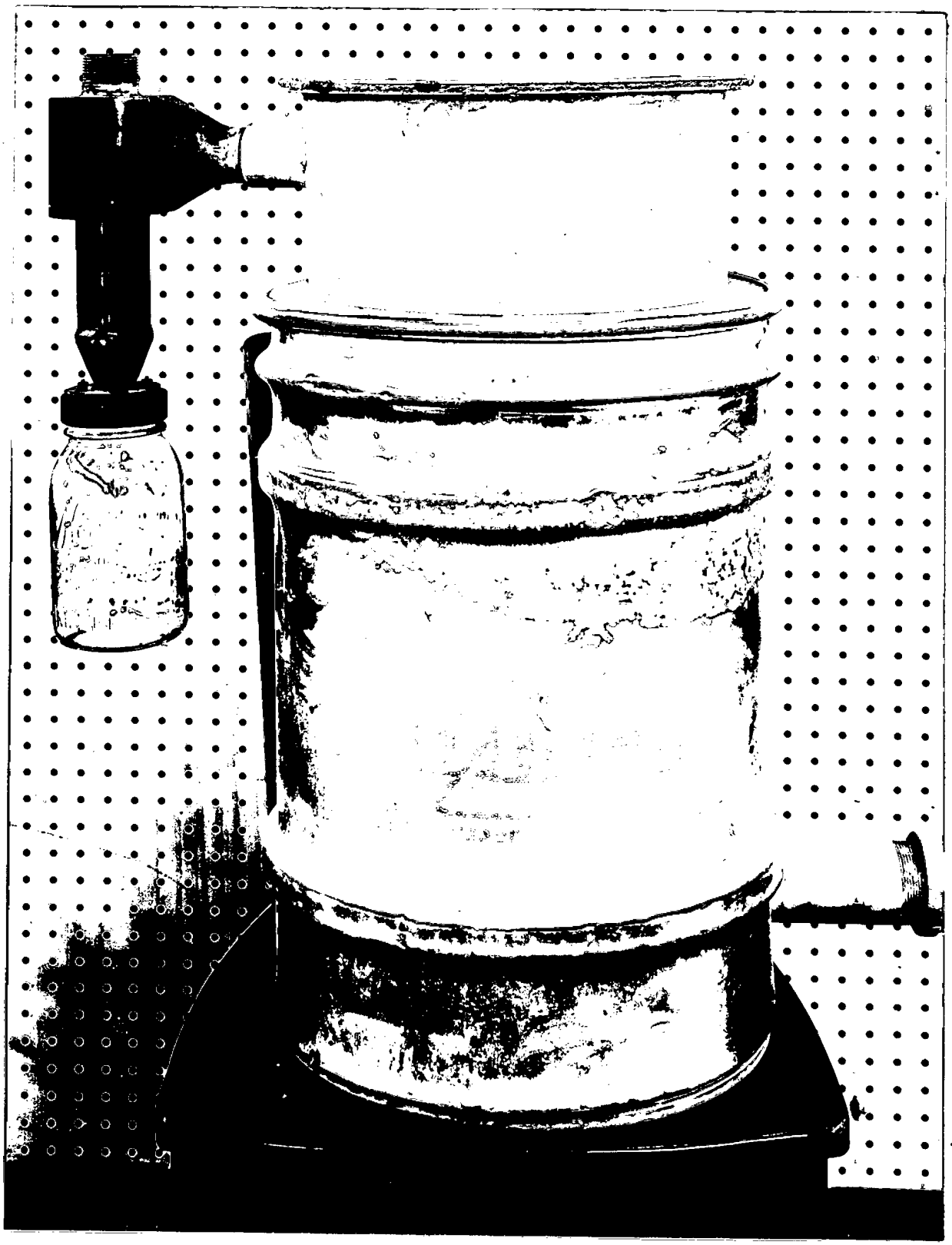


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Figure 2. Simple Laboratory Burner Used in Exploratory Experiments

from the burning of only 1/2 lb of paper was sufficiently small, compared to the weight and heat capacity of the metal liner, to permit avoiding excessive metal temperatures. A 1/2-in.-thick layer of fiber insulation on the outside of the liner was used, to increase the temperature in an attempt to achieve better burnout of the char, but little, if any, improvement resulted. A flat bottom or a conical lower section for the liner gave about the same burnout of residual char. A "floating" grid resting on top of the charge gave a slight reduction in the already low emission of fly ash, but caused poorer burnout of the residual char.

The best combination of all of the variables studied under non-turbulent combustion gave the following results:

(1) The burning time for 1/2 lb of crumpled paper held in a bag was 8 to 10 min; 1/2 lb of torn paper held in a bag burned in 13 min.

(2) Only a few flakes of fly ash were emitted in the stack gases. Thus, the emission of fly ash and char was considerably lower per pound of paper than that from the Model 1 or Model 2 high-intensity incinerators.

(3) The maximum flue-gas temperature was 600 F, which is relatively low and therefore advantageous.

(4) The pressure loss for air flow was less than 1/2 in. of water. This is reasonably low and could be provided by a quiet blower even if a low-pressure-loss fly-ash collector was found to be needed.

(5) The most objectionable feature of the non-turbulent mode of operation was poor burnout of the residual char. Up to 1 oz (about 1-1/2-qt loose volume) of char and ash remained at the end of burning. Most of the char was still legible and would have to be broken up in order to complete the destruction.

Although several simple manual methods were envisioned for breaking up the pieces of residual char, attention was turned to the application of electric resistance heating as an aid in the final burnout. The results of simple experiments with an electric hotplate showed that the char in contact with a plate at dull red heat was slowly burned to ash. However, the resulting ash insulated the remaining char, which then did not reach combustion temperature. From this, it was concluded that a stationary source of electric heat would not be adequate unless a rotating rake or plow could be used to bring the char into contact with the source. The complications of a mechanical driven rake or plow also did not appear attractive. At this point, the experimental work on the non-turbulent mode of operation was shelved and work on the turbulent mode was initiated.

Turbulent Combustion

For turbulent combustion, higher velocity air jets were used to provide agitation for better burnout and breakup of the residual char. The need for the collection of the resulting fly ash was recognized, but work on

this aspect of the incinerator was deferred until the combustion factors could be established.

A second combustion-chamber liner was then fabricated for experiments on turbulent combustion in the simple laboratory burner. This liner consisted of (1) a cylindrical upper section 12 in. in diameter and 9 in. in height, with several small air ports near the top, (2) a conical midsection which tapered to a 4-1/2-in.-diameter opening, (3) a lower "swirl pot" 6 in. in diameter and 3 in. in height, and (4) a horizontal grid near the top of the upper section. The "swirl pot" was expected to break up the residual char; it was equipped with tangential air nozzles and sharp ridges on the inside of the wall. Eighteen test "burns" were run in the above chamber using different air-flow rates and different kinds of crumpled paper held in bags. At selected air-flow rates, all of the residual char was broken up and blown out of the combustion chamber through the openings in the grid; but, at other air-flow rates, clumps of char lodged at the entrance of the swirl pot and were not broken up. Burning times of from 4 to 6 min were obtained with 1/2-lb batches of crumpled paper.

A simpler version of the swirl pot was then tried. It consisted of an annular "V" trough formed by the liner conical section and a new smaller upright cone which replaced the swirl pot. Nozzles were pointed downward and tangential to the trough, to direct air jets at relatively high velocity into the residual char. Various kinds of paper in 1/2-lb batches of crumpled sheets in a bag were burned during 17 experiments in which the burning time ranged from 2 to 10 min. Only a few small pieces of char remained in the combustion chamber at the end of each burning period. All of the ash from the paper and a noticeable amount of small pieces of char were

emitted in the stack gases. The small pieces of char were illegible because their size was limited by a new disc-type horizontal grid with 3/16-in.-diameter openings that was substituted for the larger mesh screen used previously. Some smoke was emitted during a few of the burning periods for intervals of up to 20 sec.

In view of the generally satisfactory performance of this version of the laboratory burner, except for ash emission, the development of a dust collector for cleaning the stack gas was then begun.

Dust-Collector Experiments

The outlet of the combustion chamber was fitted with a short duct, to lead the stack gases into a small cyclone dust collector. This cyclone was a commercially available 2-in.-diameter "Aerotec" tube, about 10 in. long; it was fitted with a connection for a 1-qt glass Mason jar, for catching the fly ash, as shown in Figure 2.

During 13 burning experiments with various kinds of paper, this cyclone collector caught virtually all of the small pieces of char and an appreciable amount of the fine fly ash. A slight, but unobjectionable, gray haze of fly ash was still visible at times in the flue gases during burning. The added resistance to flow caused by the cyclone increased the over-all pressure drop of the unit to about 8 in. of water. During the usual initial fast burning period, the resistance of the cyclone acted like a throttle which favorably reduced the normal surge of hot gases from the combustion chamber. The burning times were slightly longer, 5 to 10 min per 1/2-lb batch of crumpled paper, when the cyclone was used. Burnout of the residue

was fairly complete; in a few cases, up to a handful of char was left in the combustion chamber. Periods of smoking averaged less than 5 sec per batch.

Next, a filter was added to the system, to remove the last traces of haze from the flue gases leaving the cyclone collector. A cylindrical filter holder, 12 in. in diameter and 6 in. high, was fabricated from sheet metal. Two discs of a ceramic-fiber, long-staple blanket (Fiberfrax), each 1/2 in. thick, were held in place with wire mesh. The upstream disc was made of a medium-fiber material (Fiberfrax XIM, 10-micron-diameter fiber) and the down-stream disc was made of a fine-fiber material (Fiberfrax XIF, 7-micron-diameter fiber). Graded sizes of fiber were used to gain dust-retention capacity and to extend the life of the filter.

The same pair of Fiberfrax filter discs was used during the consecutive burning of eighteen 1/2-lb batches of crumpled paper (total of 9 lb of paper). The flue gases were free from haze during all but the last few of these tests, when a faint haze was detectable. The burning time, and the amounts of unburned residue and smoke emission were about the same, respectively, as in previous experiments without the filter. During this series of burning experiments, the pressure drop across the filter increased progressively from 1.0 in. to 6.7 in. of water. The total pressure drop across the combustion chamber, cyclone collector, and filter ultimately reached 11.6 in. of water. The steady increase of the back pressure as the filter loaded up with fly ash would represent a problem in the control of air flow through an unit so set up with filters.

During a meeting with the Sponsor on May 18, 1960, both the non-turbulent and turbulent modes of combustion were demonstrated without the

cyclone dust collector, with the cyclone only, and with the cyclone and the filter; 1/2-lb charges of paper, as originally planned, were used. Based on these demonstrations and a review of the prior experimental results, it was mutually concluded that an incinerator using the turbulent mode of operation, coupled with a cyclone collector (and without a filter) offered the best over-all combination for the design of a prototype, miniature-size incinerator.

Experiments With Larger Batches of Paper

During the meeting on May 18, 1960, the Sponsor indicated that it would be highly desirable for the proposed unit to be able to burn an entire bagful of packed, torn paper sheets; this quantity weighs about 4 lb, whereas 1/2 lb of crumpled paper was originally contemplated as a batch. Attempts were made to burn such a 4-lb batch on May 18; however, the turbulence was found to be insufficient to provide good burning of the larger quantity of packed paper. It was obvious that this sizeable increase in the batch weight would require extensive changes in the design of the combustion chamber and further experimentation. Consequently, the scope and objective of the program were changed so as to provide for the incineration of 4-lb batches of torn, packed sheets of paper.

For the larger batch size, a different combustion-chamber liner was built and used in the simple laboratory burner. This liner was 10 in. in diameter and 15 in. in height, and incorporated air-film-cooling louvers and inlet nozzles for the combustion air. A peripheral grid or gas-offtake section, providing 210 holes each 1/4-in. in diameter, was included in one quadrant of the upper 4 in. of the liner. During 21 burning experiments under a variety of operating conditions, including the use of several kinds of paper

and different air-jet velocities and air-flow rates, the grid plugged excessively whenever the operating conditions were such as to provide adequate agitation for the burning of the charge.

Three sheet-metal orifices of 10 in. outside diameter and with holes 2, 4, and 6 in. in diameter, respectively, were consecutively installed within the combustion chamber in a horizontal position just below the side grid, in an attempt to hold the swirling paper in the combustion chamber. During 24 burning experiments under these conditions, grid plugging persisted.

A central cylindrical grid, 5 in. in diameter and 4 in. in height, with a solid bottom and 4-mesh (4 wires per in.) wire-screen sides, was tried under a variety of burning conditions. Also, the small cyclone dust collector, used previously, was installed at the outlet of the grid. During 59 burning experiments with various arrangements of air nozzles and with and without louver air, either the grid plugged or burnout of the residue was not satisfactory. Further efforts made in 16 burning experiments using a horizontal disc of wire screen below the central grid were also unsuccessful with 4-lb charges of torn, packed paper.

Thirteen burning experiments with 1-, 2-, and 4-lb charges of various kinds of paper showed that reducing the charge from 4 lb to 2 lb improved the over-all performance to the extent that a satisfactory compromise in design appeared possible. Consequently, during discussions with the Sponsor on September 14, 1960, it was mutually agreed that the project objectives be revised to provide for the incineration of 2 lb of paper per batch. In addition, the use of just one kind of paper in a single charge was changed in favor of using mixtures which would represent more typical day-to-day charges. Also, the louvers in the combustion chamber were closed.

Since the difficulties stemming from grid plugging still represented the major obstacle to satisfactory operation, 94 burning experiments were run with 2-lb charges and several kinds of grids, as follows:

(1) An inverted conical grid of wire mesh, 4 wires per in. with 3/16-in. square openings; the apex of the cone was cut off in order to obtain a 1-1/2-in.-diameter opening so as to minimize plugging.

(2) The same grid as above, but without the 1-1/2-in.-diameter opening.

(3) The same shape of inverted conical grid as above, but with larger and diamond-shaped mesh openings, 5/16 by 1-in.

(4) The same shape of inverted conical grid as above, but with 3/4-in.-diameter holes spaced on 1-in. centers.

(5) A central cylindrical grid of 4-mesh (4 wires per inch) wire screen, with an open bottom.

(6) No grid.

The best burnout of residual char was obtained when the air flow was not restricted by grid plugging; this occurred during experiments without a grid and during experiments with the bottom removed from the central cylindrical grid. However, under these conditions, small pieces of unburned paper were found occasionally in the ash container, and once in the flue gases,

toward the end of one burning experiment. Therefore, it was decided that the risk of discharging legible pieces of paper warranted the use of a grid at the combustion-chamber outlet.

The inverted conical grid with 3/4-in.-diameter holes was sufficiently free from plugging to cause only a slight restriction to the air flow, and burnout of the char was acceptable. In 25 experiments, no legible pieces of char were emitted with the flue gases. Most of the mixtures of papers were burned with little or no smoke and odor. A slight visible haze of powdered fly ash was noted in the flue gases during the burning of certain kinds of heavy paper. The haze was absent for all but the last minutes of the burning period for onionskin or similar types of paper.

Conclusions From Exploratory Experiments

After the many above-described changes in the configuration of the combustion chamber were made, and 388 exploratory burning experiments were completed, the results were considered sufficiently encouraging to warrant building an experimental version of the miniature-size incinerator for 2-lb batches of paper.

The final, most satisfactory, design provided a combustion chamber which was 15 in. high. It consisted of a 10-in.-diameter cylinder with a bottom made of two conical sections which formed a "V"-shaped circular trough similar to the bottom of the larger Model 1 incinerator. Cooling-air louvers were not needed in the combustion chamber, and the entry ports for combustion air were simply 32 drilled holes of 3/16-in. diameter. A small cyclone dust collector of conventional design performed satisfactorily in reducing the emission of fly ash from this combustion chamber.

THE EXPERIMENTAL MODEL 3, MINIATURE-SIZE UNIT

A design for the experimental unit was prepared, and subsequently reviewed and approved by the Sponsor on October 11, 1960.

Description of Unit

Figure 3 is a photograph of the experimental Model 3 unit being loaded with a bag of paper. The perforated grid was attached to the loading door and could easily be inspected for any lodged residue when the loading door was open. Air for combustion and cooling entered through the grill near the floor at the front of the unit. Flue gas exited through a 4-in.-diameter pipe which was to extend through an open window.

Figure 4 is a photograph of the Model 3 unit that shows the covers open on the back compartments. The lower compartment contained the blower and was lined with sound-insulation to quiet air-flow and blower noise. The upper compartment held the fly-ash container. A hand wrench and extra nuts for the "V"-band joint on the fly-ash container were set up in a rack on the upper-compartment cover. A metal "V"-band joint was used to attach the fly-ash container to the cyclone dust collector; the temperature at this location exceeded the allowable limit of most soft gasket materials. The cleaned flue gas was discharged at the top of the cyclone, where it mixed with cooling air in the flue connector.

After this Model 3 unit was shipped to the Sponsor, a movable platform or "dolly" was provided. It was made to fit the bottom of the unit and had 4 casters equipped with rubber tires. The over-all height of the unit was

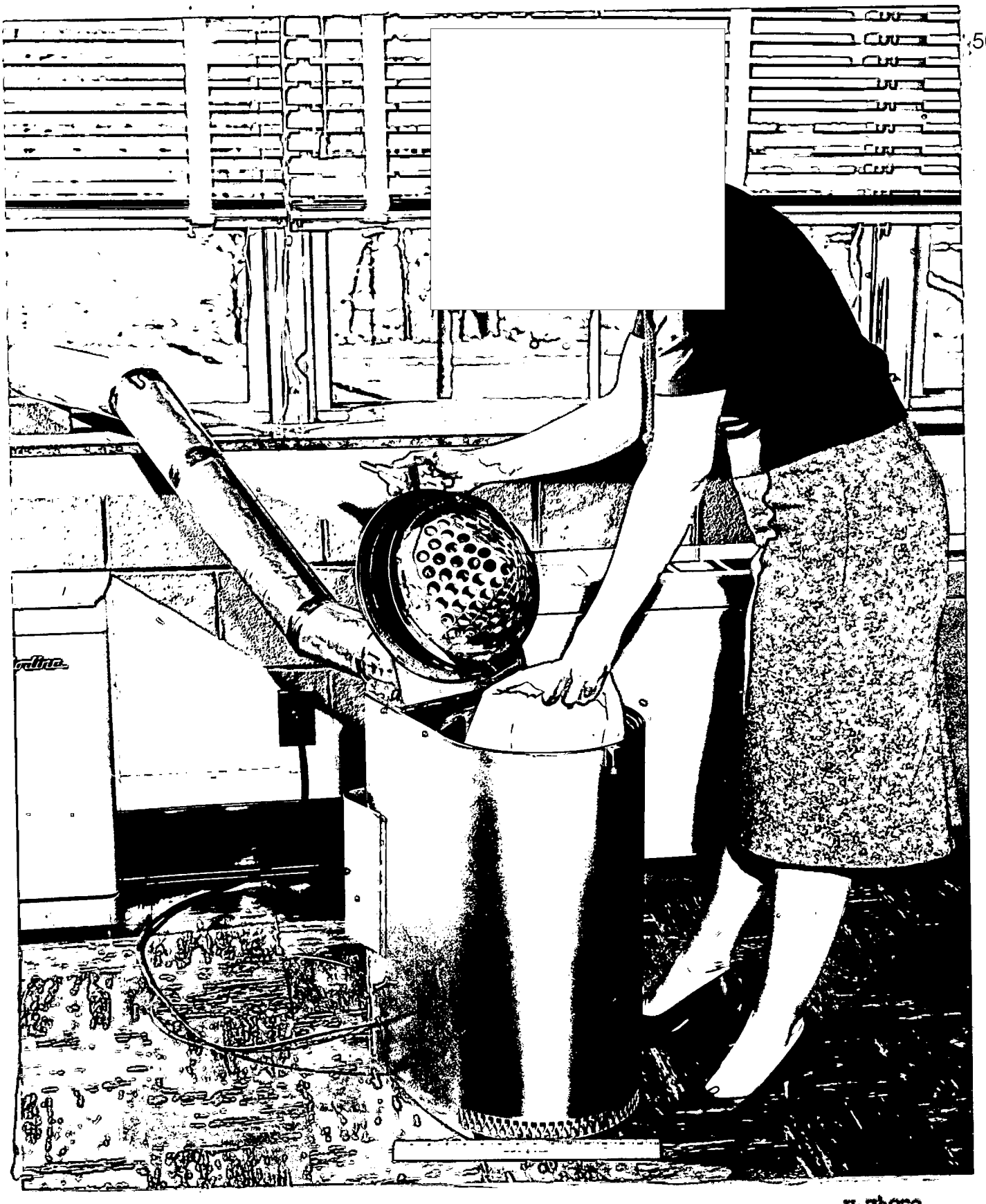

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Figure 3. Experimental Model 3 Unit With Loading Door Open

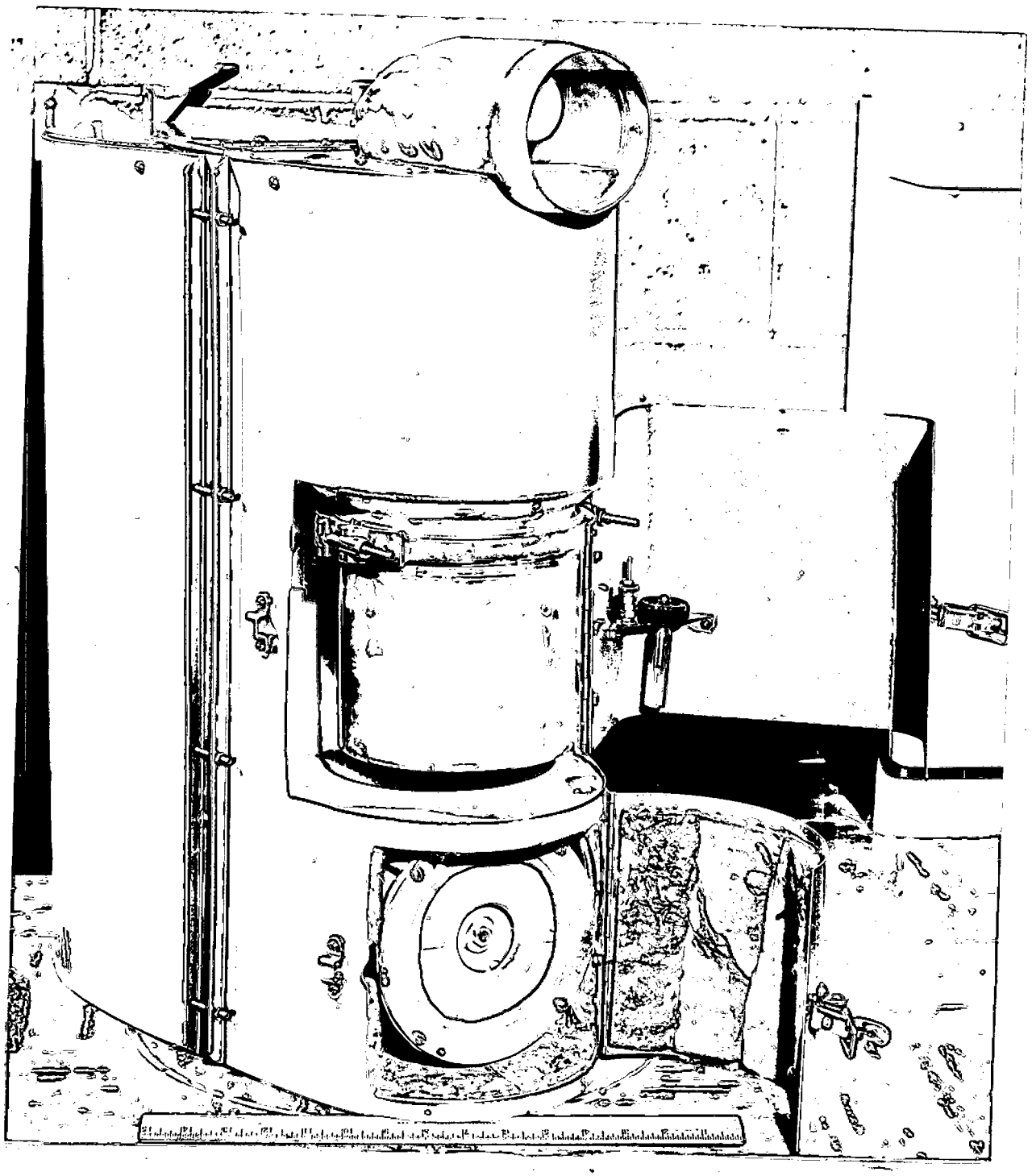

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Figure 5. Experimental Model 3 Unit With Each Covers Open

increased 2-1/2 in. by the dolly. A small poker for breaking up the residue in the combustion chamber was also provided. Later, a bill of materials for the unit was prepared; it is included in Appendix 1.

Figure 5 in Appendix 2 is a full-scale layout drawing which shows two views of the Model 3 unit. The flow paths of air and flue gas are also shown in Figure 5. The combustion chamber, radiant-heat shield, and other internal parts of the unit that contacted the hot flue gas were made from Type 310 stainless steel. The unit weighed 85 lb, not including the flue pipe and the dolly. The exterior finish was a gray Hammerloid enamel.

Results of Laboratory Operating Trials

Instead of our usual procedure of thoroughly evaluating the performance of a newly constructed experimental unit and modifying it if necessary, it was agreed at a meeting with the Sponsor on November 1, 1960, that a short period of effort, of not more than two days, would be devoted to a preliminary evaluation. If satisfactory performance was indicated by this brief evaluation, the experimental unit would be sent to the Sponsor immediately for a field-type evaluation and for demonstration to his associates.

The laboratory evaluation consisted of 12 burning experiments made with 2-, 1-, and 1/2-lb batches of various kinds of paper. During the first 4 trials, minor modifications were made in the proportion of fan air used for combustion and for cooling, by drilling additional cooling-air ports until desirable burning characteristics were obtained. The cold-air-flow static pressure in the plenum chamber between the blower and the combustion chamber was 8.6 in. of water after these modifications. A similar pressure measurement

can be used in future units to check the proportion of combustion air and cooling air.

For this unit, the operating procedure used consisted of (1) placing the bag of paper in the unit, (2) igniting the bag or the loose paper at the top of the bag, (3) quickly closing the loading door and turning on the blower, (4) observing the fire occasionally through the sight port until the paper burned out, and (5) examining the residue at the end of the burning period.

The results of the burning experiments were as follows:

(1) Burning times varied from 6 to 22 min depending on the weight and type of paper used.

(2) No unburned, legible paper was found in the residue after the burning periods. The residue in the combustion chamber was mainly ash, but contained from a few pieces up to 1/2 cupful of fragile char which was easily broken up by stirring or poking. No legible material was found in the fly-ash container. A large fraction of the ash remained in the combustion chamber; thus, several batches could be burned before emptying the ash container.

(3) The emission of fly ash and smoke in the flue gas was very low during most of each operating period. Near the end of burning, a slight haze of fine fly ash was visible in the flue gas.

(4) The temperatures of the outer painted surfaces were from 140 to 245 F on the sides of the unit and from 145 to 285 F on the top of the unit. The ash container reached 305 F (inside the casing) and the flue pipe reached 600 F. Except for the stack, all of the outer surfaces of the unit could be touched with a bare hand during paper-burning operation without danger of the hand being burned.

(5) Metal temperatures of the inner combustion chamber were from 1500 to 1800 F. These high temperatures favored good burnup of the residue and could be tolerated by the Type 310 stainless steel which was used for the combustion chamber.

(6) The operating noise level was considerably less than that of a household vacuum cleaner which uses the same type of high-speed blower.

The results of the preliminary evaluation showed that the major objectives of developing an experimental miniature-size incinerator were achieved. On December 2, 1960, the unit was shipped to the Sponsor for further evaluation and demonstration under field conditions.

Field Evaluation and Commercial Fabrication

During a period of about two months, the Sponsor operated the experimental Model 3 unit using a variety of papers. The Sponsor and his

associates concluded that its performance was satisfactory and that a need existed for a number of such units. Arrangements were then made by the Sponsor for the commercial fabrication of one production unit and for the preparation of shop drawings by the fabricator. During this phase of the Sponsor's program, our activity consisted of providing technical advisory services under Task Order No. TT, Work Order No. 9. This activity was described in our letter report dated August 14, 1961, which is summarized in the following paragraph.

On May 18, 1961, a selected member of our engineering staff accompanied the Sponsor to the fabricator's plant to discuss the design and construction of the Model 3 unit. Copies of all original sketches and the revised layout drawing shown in Figure 5 of Appendix 2 were furnished to the fabricator. The encircled call-out numbers on Figure 5 refer to the part numbers on the original sketches. A few minor changes were mutually agreed upon. Also, it was called out to the fabricator that particular emphasis should be placed on providing the proper size of air passages in order to obtain the same distribution of combustion air and cooling air as that set up in the first experimental unit. In addition, the Sponsor requested that a microswitch be installed to prevent operation of the blower when the door was open, and that a handle be installed on each side of the unit to facilitate carrying.

By August 1, 1961, the shop drawings prepared by the fabricator had been checked and found to be satisfactory.

FUTURE WORK

In view of the immediate need for several production units, the Sponsor anticipated that further advisory services might be needed during acceptance testing and preparation of an instruction manual. (At the Sponsor's request, a proposal was submitted on August 4, 1961, for the provision of further technical advisory services in connection with the Models 1, 2, and 3 incinerators. This was subsequently set up as Work Order No. 1, Task Order No. 9.)

APPENDIX 1

BILL OF MATERIALS FOR MODEL 3 UNIT

APPENDIX 1

Bill of Materials for Model 3 Unit

Approximate Quantity	Material
1 sq ft	Stainless steel sheet, Type 304, 11 gage
20 sq ft	Stainless steel sheet, Type 310, 16 gage
12 sq ft	Stainless steel sheet, Type 304, 26 gage, No. 4 polish on one side
12 sq ft	Stainless steel sheet, Type 304, 18 gage
8 sq ft	Stainless steel sheet, Type 304, 22 gage
1 sq ft	Hot-rolled steel sheet, 7 gage
1 sq ft	Hot-rolled steel sheet, 11 gage
1 sq ft	Hot-rolled steel sheet, 14 gage
5 sq ft	Hot-rolled steel sheet, 16 gage
20 sq ft	Cold-rolled steel sheet, 20 gage
10 sq ft	Cold-rolled steel sheet, 24 gage
2 sq ft	Expanded steel mesh, flattened, 1/2 x 18-20
1 ft	Cold-rolled steel bar, 1/8 x 1/2"
1 ft	Cold-rolled steel bar, 3/16 x 1"
1 ft	Cold-rolled steel bar, 1/4 x 3/4"
2 ft	Cold-rolled steel bar, 1/2 x 1/2"
1 ft	Cold-rolled steel bar, 5/8 x 5/8"
1 ft	Cold-rolled steel bar, 1/8 x 1"
25 ft	Angle iron, 1/8 x 1/2 x 1/2"
1 ft	Angle iron, 1/8 x 1 x 1"
1 ft	Stainless steel tubing, Type 304, 5/16" OD, 20-gage wall
1 ft	Stainless steel tubing, Type 304, 2-1/2" OD, 16-gage wall
1 ft	Stainless steel pipe, Schedule 5, Type 304, 1-1/4" Nominal
1	Stainless steel elbow, 90°, Schedule 5, Type 304, 1-1/4" Nominal
1	Short pipe nipple, black iron, Schedule 40, 1/2" Nominal
1	Pipe union, galvanized or black, for 1/2" pipe
1 ft	Stainless steel rod stock, Type 304, 1/8" OD
1 ft	Drill rod, steel, 3/16" OD
--	Type 310 stainless steel filler rod for Heliarc welding
--	Type 304 stainless steel filler rod for Heliarc welding
1	Allen-head cap screw, 3/8"-18, 3/4" long
1	Allen-head set screw, cup end, 3/8"-18, 1/4" long
4	Steel compression spring, 7/16" OD, 2-5/8" long, 0.0475"-diameter wire (Raymond #D25, or equivalent)

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Approximate Quantity	Material
1	Steel compression spring, 1/2" OD, 2-1/2" long, 0.0625"-diameter wire (Raymond #D24, or equivalent)
1 sq ft	Dense asbestos gasket, 1/16" thick (Cranite or equivalent)
1 plus 2 spare	Rubber "O" ring, Buna N, 12" OD, 1/4"-diameter section
2	Flanges ("V"-band type), 6" ID (Janitrol Part #K05C17)
1	Clamp assembly ("V"-band type), 6" size (Janitrol Part #A07C05)
	Note: Above two items can be obtained from Midland-Ross Corporation, Janitrol Aircraft Division, 4200 Surface Road, Columbus, Ohio
1 pt	Aluminum paint for inside of unit
2 cans	Gray enamel, small pressurized spray cans of Chromatone Hammer finish enamel from Chromatone Corporation, Los Angeles, California, or St. Louis, Missouri
2 pr	Drawer pull catches (for rear covers), cadmium-plated steel, 2-1/2 x 1/2" over-all size (Corbin #15250C, or equivalent)
4-ft length	Piano hinge, bright-nickel-plate steel (Stanley Sc 311-N-1 1/2 x 48, or equivalent)
1	Vacuum-cleaner-type blower, 2 stage, #14750 blower, Lamb Electric Company, Kent, Ohio
10 sq ft	Sound-absorbing glass wool, 1/2" thick (#200 Ultralite or equivalent)
1 pt	Flexbond (Goodyear) cement, or equivalent
1 sq ft	Sponge-rubber pad, 1/4" thick
4 x 4 in.	Pyrex-glass plate, 3/16" thick
1	Toggle switch, single-pole single-throw, 110 v, 12 amp
15 ft	Extension cord, 110-v, rubber covered, with plug at end
2 ft	Rubber tubing, 3/16" ID, 3/32" wall
1 ft	Copper tubing, 3/16" OD
1	Socket wrench, 7/16", 12 point, deep style
2 ft^2	Steel-wire cloth, No. 4 mesh, 0.092"-diameter wire
	Assortment of machine screws, nuts, and washers for assembly; some of the washers and nuts are of stainless steel.

APPENDIX 2

DRAWING OF MODEL 3 UNIT

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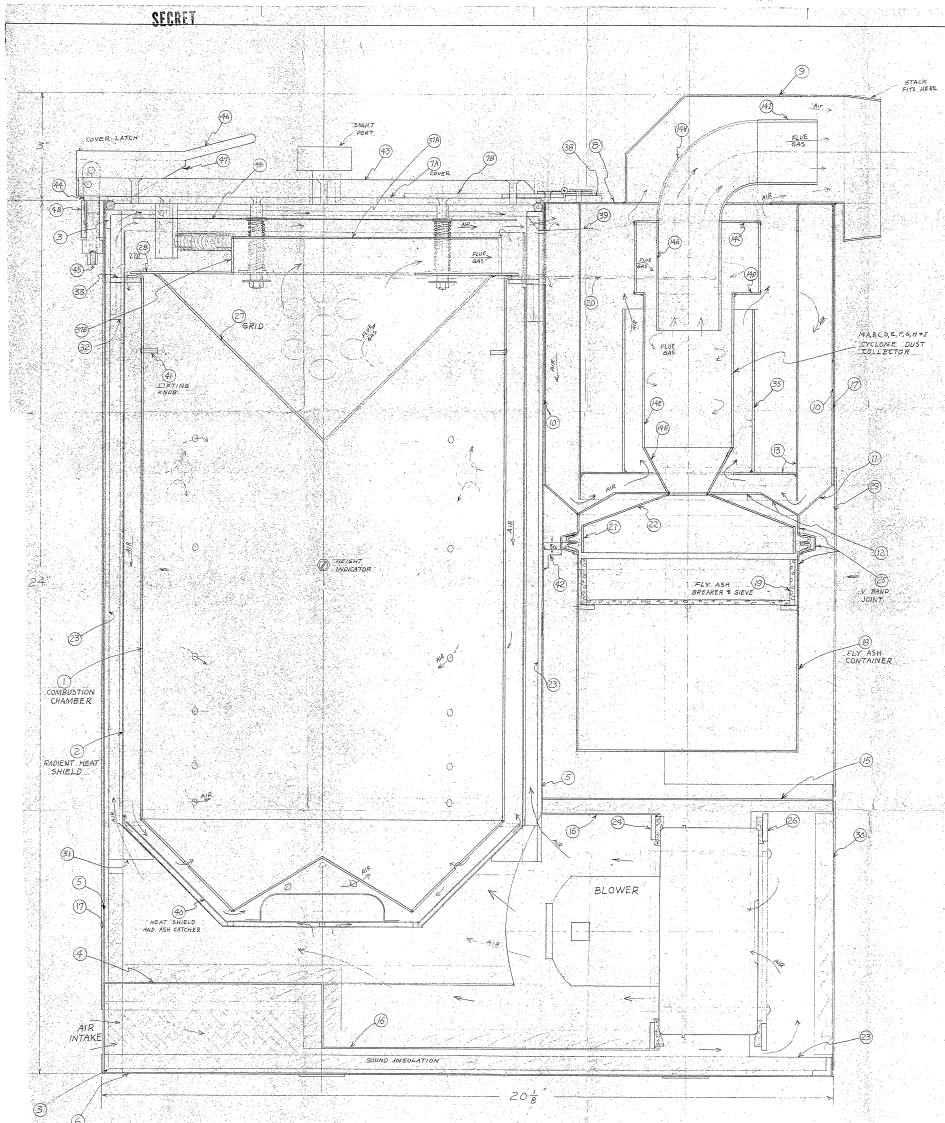

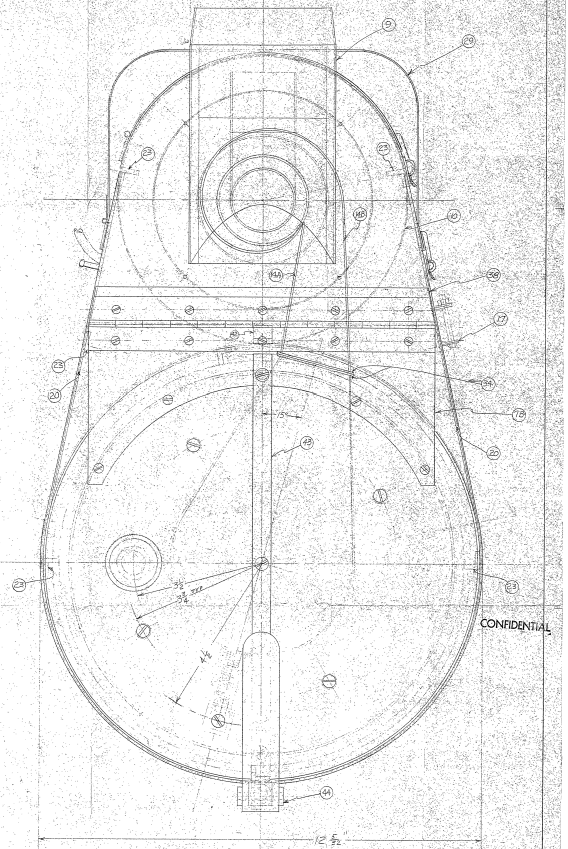

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FIGURE 5 MODEL 3 EXPERIMENTAL MINIATURE-SIZE INCINERATOR

FULL SCALE LAYOUT VIEWS

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