CLINTON ENGINEER WORKS - TENNESSEE EASTMAN CORPORATION

Process Improvement Division

Technical Report

TITLE : CLEANING E-UNITS BY BLASTING

ABSTRACT : An air-water-abrasive blasting system thoroughly cleans copper parts of E units without damage to the parts. Little abrasive is required because of the continuous recycle of the abrasive slurry.

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DISCLAIMER

CLEANING E-UNITS BY BLASTING

Object : To remove E-End Material from E-Units.

Equipment : Enclosed shield with glass window in the front for observation, large exhaust fan, connecting pipe with filter to connect shield and exhaust fan, small abrasive pump, mixing chamber, agitator, nozzle.

Material : Corundum (Aluminum Oxide) about 150 mesh, Copper dust about 325 mesh, compressed air, and water.

Procedure : The cleaning unit consisted of a large enclosed shield with a section of the front sliding, a large exhaust fan connected to the shield by a 9 inch galvanized iron pipe in which was inserted an air filter. A mixing chamber was used to hold the abrasive mixture, and a small pump was used to pump the slurry to the nozzle. The nozzle was inserted through the sliding portion of the front of the shield and sealed to this slide by a rubber sleeve. This blasting nozzle had two feed lines entering at its manifold. Through one line a 50% by weight mixture of corundum and water was pumped, and through the other compressed air entered the nozzle. The nozzle was designed to give good abrasive dispersion and give the air the chance to impart high velocity to the abrasive particles as the air swept by the abrasive outlet. The high velocity particles of abrasive leaving the nozzle would literally knock the E-end material from the E-Unit parts.

The compressed air entering the shield was pulled from the shield through a filter and expelled to the atmosphere. Any material in the exit air should be removed by the filter in the exhaust line.

The wet abrasive after striking the target fell to the bottom of the shield and went into the drain that led to a mixing chamber from which the slurry was pumped to the nozzle; thus the abrasive mixture was being constantly recycled. Thus a small amount of abrasive was all that was required.

The E-Unit parts were inserted in the shield by removing the front glass window. The glass window was then placed back on the shield, and the part was blasted for several minutes until all the black material was removed. The part was then removed, washed, and dried.

Outline of Results: On December 14, 1944, the E-Unit cleaning assembly was installed in Building 9201-5 and placed in experimental operation. An attempt to clean each separate part of the dismantled E-Unit was undertaken.

Parts from the dismantled E416 were all cleaned well by close range blasting, the nozzle to target distance varying from 2" to 5". The outlet of the nozzle was 1/4" inside diameter, giving a small cleaning area at close range.

Parts were blasted from all angles until the characteristic black E-end material was completely removed. The most difficult part to clean was the bird cage. The material came off easily under blasting, but much time was required to turn the part to allow blasting from every angle. The actual time to clean the bird cage was 30 min. Other parts required less time.

The total working hours spent in cleaning E-416 were 15.

The black E-end material was removed almost instantaneously from the major surface area of the parts by blasting, but in some places the E-end material on the parts was very resistant to removal. On these parts several seconds of concentrated blasting were required on small areas; the material, however, was removed after a short time. For example, one patch on a bird cage cover had material caked on it that was hard to remove by vigorous rubbing with emory paper, but the blasting removed this material after several minutes.

E-456 and E-422 were also cleaned by blasting with the same results as with E-416. Several demonstrations were made during this time, all of which showed the desired results.

The corundum was recycled and only a small amount, about 8 pounds, was used to clean several E-units. The corundum apparently was little, if any, affected by the blasting. Its cleaning property was retained even after 20 or 25 hours of use.

A study was made of the compressed air used. Satisfactory cleaning was done at pressures as low as 20 to 30 p.s.i., but with increased air pressure the target distance could be increased. The target distance, the distance from the nozzle tip to the surface to be cleaned, increased to 1 ft. at 35 p.s.i. All pressure readings were gage readings.

At a target distance of 1" the area being blasted was about 1/4" in diameter. At a target distance of 1 ft. this was about 2" in diameter.

An experiment was made to determine the effect of blasting a copper surface. The maximum depth of penetration which occurred at 35 p.s.i. pressure, target distance 3", and blasting time 30 sec., was only 0.0025". Under normal blasting conditions copper was not deeply penetrated. The copper samples blasted were examined under a microscope at 100X after being blasted, and no definite pitting action, but more of a ridge effect, was found. A few imbedded particles of alumina were also found. The surface looked and felt smooth both before and after blasting.

Samples of the abrasive mixture were taken after several hours of operation and sent for analysis. The pH of the mixture was 6.4 and the concentration of T in the abrasive was 1%. Twice the supernatent of the abrasive mixture was sent for analysis, and the first test showed a T concentration of 45 mg. per liter, while the second showed 24.3 mg. per liter.

The performance of the units after being blasted when placed in operation on the track was normal. Pump down of E-416 took 21 hours, compared with a 24.6 hours track average.

The air filter in the exhaust line worked very well. This filter was composed of alternating layers of copper turnings and wood shavings soaked in oil. All T particles or abrasive particles entering the exhaust line were caught by this filter.

An experiment with copper dust on the order of 325 mesh as the abrasive was carried out, but proved unsatisfactory. The hard material could be removed only by prolonged blasting.

Summary and Conclusions: The results of this experiment show that the E-end material can be removed from the E-unit parts without damage to the parts.

The equipment, although simple, performed very well throughout the experiment. The continuous recycle of the abrasive mixture was accomplished, by which method only 8 pounds of abrasive were required to clean all the units in the experiment. The abrasive, corundum, was apparently unaffected by continuous use. This shows the possibility of using corundum indefinitely without pronounced effect on its cleaning characteristics.

The actual blasting time for cleaning E-416 was 4-2/3 hours, but 15 working hours were required. This shows that 67% of the total time was spent in handling the parts, in maintenance, and in major overhauling of equipment. With better equipment this time would be reduced.

At a target distance of one inch the surface being blasted at any time was approximately 1/4" in diameter. If the target distance was increased to 1 ft. the surface being blasted was over 2" in diameter. Since the flow of abrasive can be considered constant, a much larger area was being cleaned at the longer target distances for the same amount of abrasive, and since the abrasive particles are more spread out, the cleaning is slower. However, if more abrasive were introduced at high air pressures the cleaning would be more rapid at great distances.

The copper is not eroded excessively under blasting when one considers that the maximum depth penetration of 0.0025" occurred at high air pressure and very close target distance with a 30 sec. blasting time. In actual blasting the longest period of concentrated blasting on any point would rarely ever exceed 2 or 3 sec. Blasting at target distances of one foot even for prolonged time causes only a slight depth penetration.

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ORIGINAL DATA

BLASTING TIME ON E-UNIT PARTS

PART	AVG. TIME TO CLEAN
Bird Cage	30 min.
Screen and Back	15 min.
Copper Cooler for R-Can	10 min.
Side Shutter Holder	5 min.
Stainless Steel Part	5 min.

TOTAL BLASTING TIME ONLY TO CLEAN E-UNIT

PART	NO. OF PARTS OF THIS TYPE	AVG. TIME TO CLEAN ONE PART	TIME TO CLEAN ALL PARTS
Bird Cage	4	30 min	2 hr.
Screen and Back	4	15 "	1 "
Copper Cooler for R-Can	4	10 "	2/3 "
Side Shutter Holder	8	5 "	2/3 "
Stainless Steel Part	4	5 "	1/3 "

TOTAL BLASTING TIME FOR ALL PARTS - - - - - - - - - - - - - - - - 4-2/3 hours

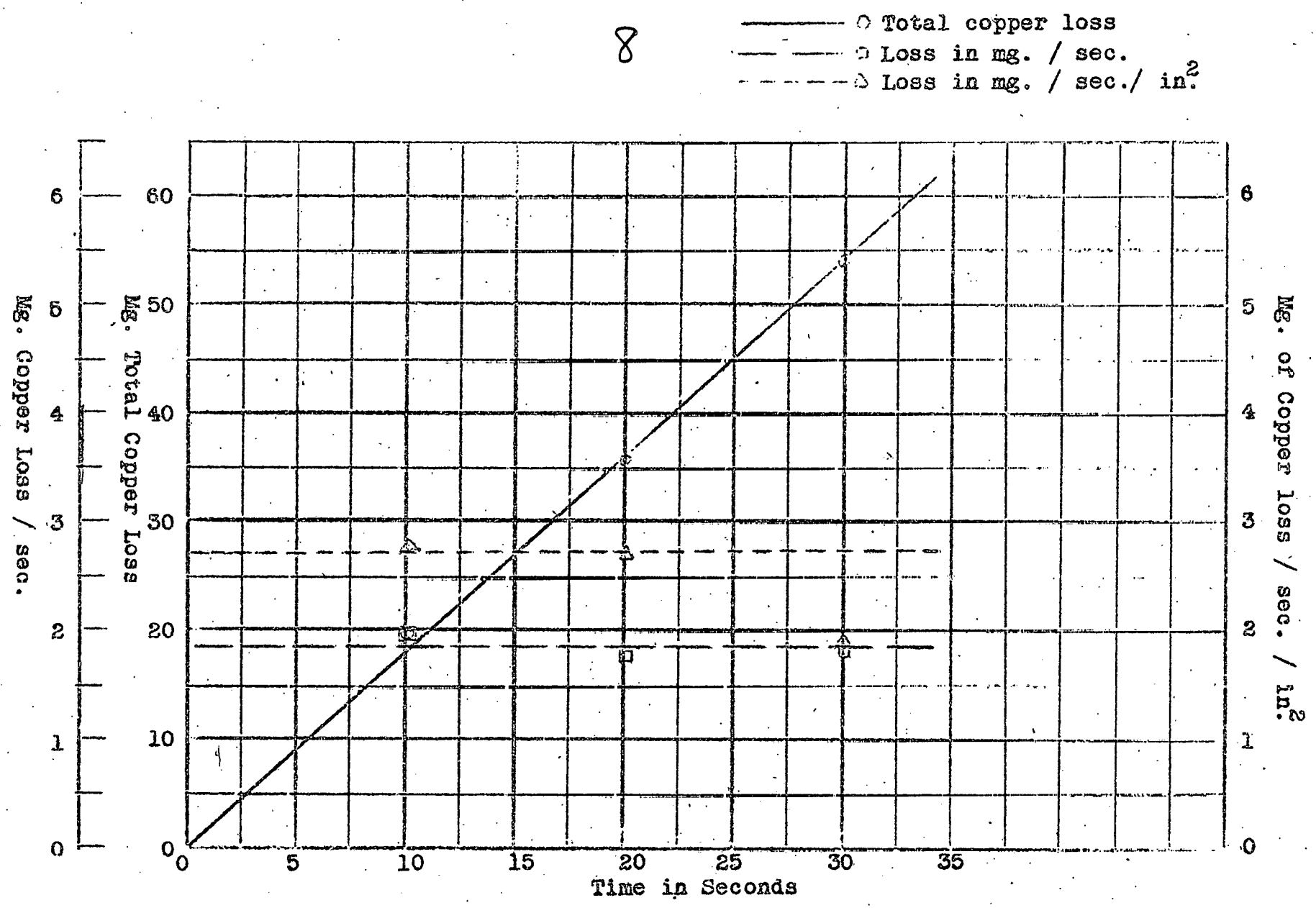
ORIGINAL DATA

E-END BLASTER EFFECT ON COPPER SURFACE

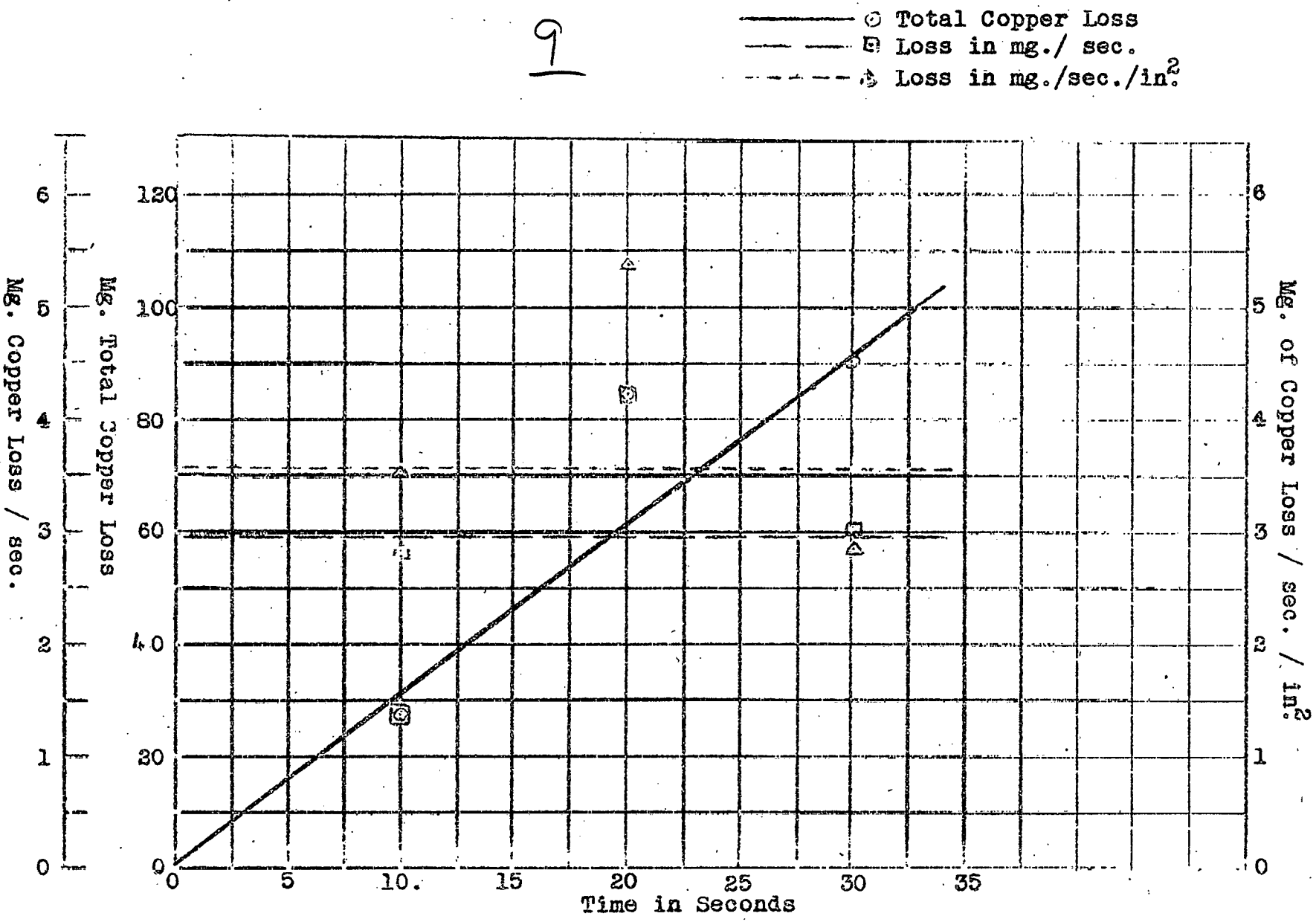
Sample No.	Target Dist.in.	Press. p.s.i.	Time Sec.	Orig. Wt. Grams.	Final Wt. Grams	Area in^2	Max. Depth of Penetration in.x10^{-3}
1	3	25	10	14.1759	14.1623	.601	.5
2	3	25	20	14.0175	13.9837	.601	1.25
3	3	25	30	14.0064	13.9384	.994	2.0
4	3	35	10	14.0370	14.0096	.785	1.0
5	3	35	20	13.6060	13.5214	.785	1.5
6	3	35	30	13.3542	13.2407	.994	2.5
7	12	35	60	13.5292	13.4705	2.750	1.0
8	3	25	10	14.1623	14.1365	.785	.5
9	3	25	20	13.9837	13.9451	.785	.75
10	3	25	30	13.9384	13.8935	.994	1.0
11	3	35	10	14.0096	13.9816	.785	1.0
12	3	35	30	13.2407	13.1736	1.230	.5
13	12	35	60	13.4705	13.4010	2.750	1.0

Samples were 1/32 inch copper sheet with a mass of 4.6 grams per sq. in. of surface area.

Sample No.	Target Dist. in.	Press. p.s.i.	Time sec.	Orig. Wt. Grams	Fin. Wt. Grams	Loss mg.	Loss mg/sec.	Area in^2	Loss $mg/sec/in^2$	Avg. depth of Penetration $inx10^{-3}$	Max. depth of Penetration $inx10^{-3}$
1	3	25	10	14.1759	14.1623	13.6	1.36	.601	2.26	.15	.5
2	3	25	20	14.0175	13.9837	33.8	1.69	.601	2.81	.382	1.25
3	3	25	30	14.0064	13.9384	68.0	2.26	.994	2.27	.465	2.0
4	3	35	10	14.0370	14.0096	27.4	2.74	.785	3.49	.237	1.0
5	3	35	20	13.6060	13.5214	84.6	4.23	.785	5.39	.732	1.5
6	3	35	30	13.3542	13.2407	113.5	3.78	.994	3.80	.789	2.5
7	12	35	60	13.5292	13.4705	58.7	.98	2.750	.356	.145	1.0
8	3	25	10	14.1623	14.1365	25.8	2.58	.785	3.29	.223	.5
9	3	25	20	13.9837	13.9451	37.8	3.78	.785	2.41	.327	.75
10	3	25	30	13.9384	13.8935	44.9	4.49	.994	1.50	.307	1.0
11	3	35	10	14.0096	13.9816	28.0	2.80	.785	3.57	.243	1.0
12	3	35	30	13.2407	13.1736	67.1	2.24	1.23	1.82	.371	.5
13	12	35	60	13.4705	13.4010	68.5	1.14	2.75	.415	.170	1.0



EFFECT OF BLASTING ON COPPER (25 psi, 50% by wt.Abr.)



EFFECT OF BLASTING ON COPPER (35 psi, 50% by wt. Abr.)

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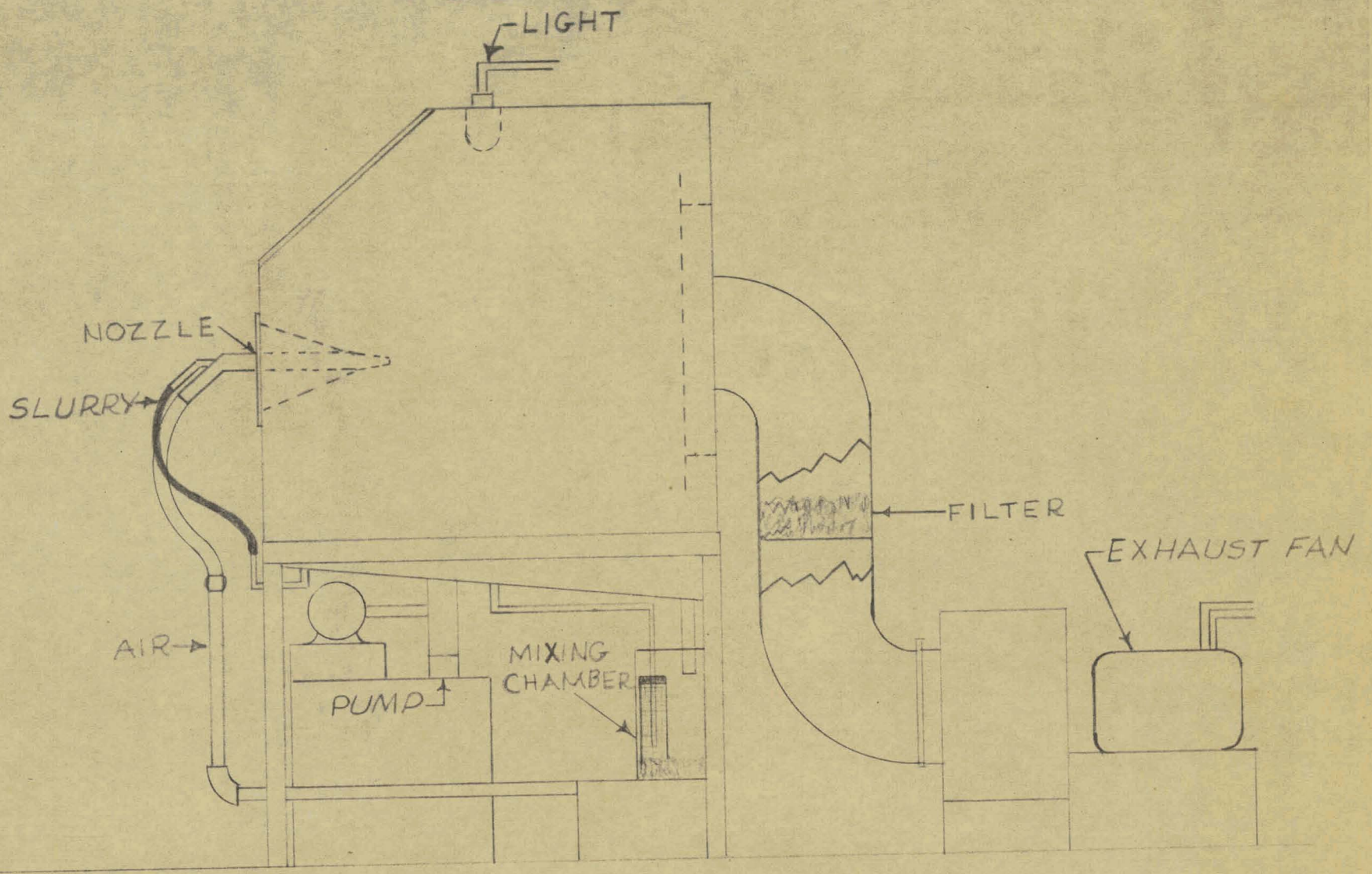

BLASTER ASSEMBLY

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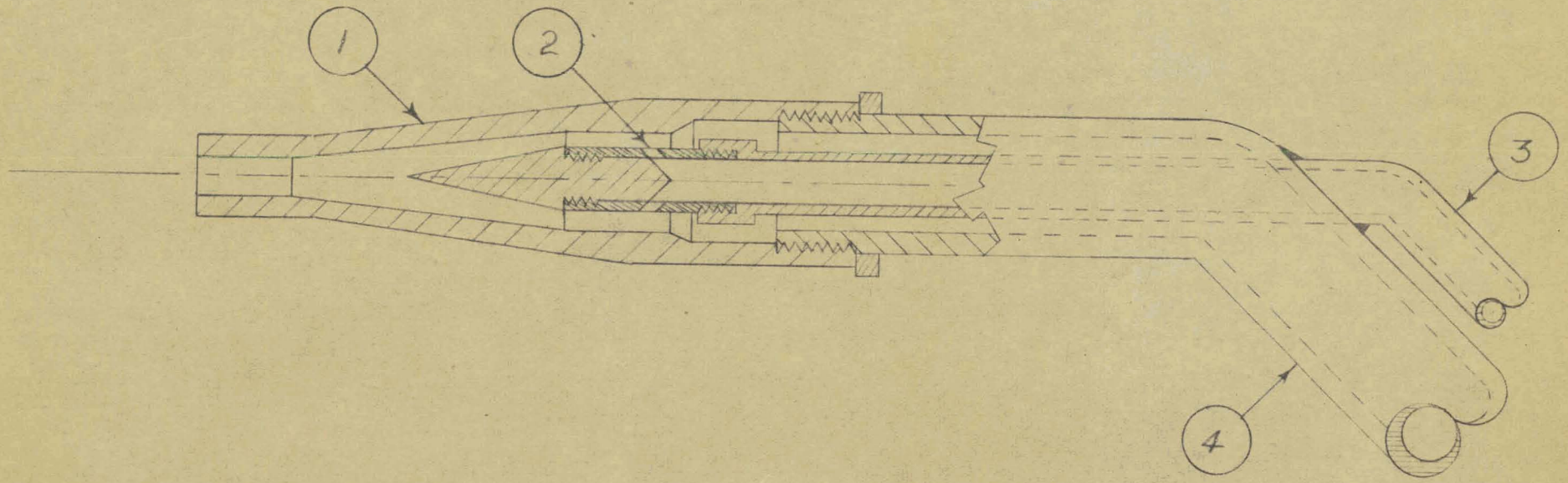
1	NOZZLE
2	SLURRY ENTERS AIR STREAM
3	SLURRY LINE
4	AIR LINE



PRESSURE FEED NOZZLE

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