Restoring Chemical Warfare M1 Collective Protector System
Battery Gunnison/New Battery Peck
Ft. Hancock, New Jersey

In the spring of 2014, the Army Ground Forces Association began locating and fabricating the required materials to restore the M1A1 Collective Protector Chemical Warfare system in Battery Gunnison/New Battery Peck. During this time AGFA was able to obtain a very significant quantity of original chemical warfare equipment, to include a 3,500 rpm AC motor and blower, switches, valves, pulleys and ancillary materials. Most of this equipment was in good to excellent condition and well within the capabilities of the membership to restore to a functional condition.

In 2017 we expanded the project to include restoring a single decontamination chamber inside the mortar battery (former Harbor Defense Command Post) with a working blower and motor. This will be discussed in more detail in a report specific to the Harbor Defense Command Post (Mortar Battery).

There are essentially two distinct chemical warfare air handling systems in Battery Gunnison/New Battery Peck. One is a chemical decontamination chamber in between the plotting room and the Chemical Warfare equipment room and the other is the blower, motor and filer system for establishing an over-pressure state in the plotting room located inside the Chemical Warfare equipment room.

The Battery Gunnison/New Battery Peck system requires two 110 volt AC 3,500 rpm motors, a decontamination stand pipe, two motor cutout boxes, a cable actuated switch for the red chamber use indicator light, reproduction treadle plate, and a cable actuated switch to turn on the blower motor for the decontamination chamber. All of these items were obtained and restored. The treadle and much of the stand pipe was fabricated from new materials. The majority of the cast iron pipe is modern pipe fitted to historic pipe. Threading is the same, and in some cases the historic threading required little cleaning to function as intended.

The location for the M1 Collective Protector is shown below as it existed in Oct 2012. The four existing pipes (three top of room, one on floor) were all that remained of the original installation. In 2011 the vintage lighting pictured was re-installed. The lighting was revised to the correct configuration for 1943 in 2018.

AGFA is fortunate to have high resolution PDF scans of the conversion drawings from 1943 that include section and plan views of the Chemical Warfare system. This provides critical details required for the re-installation of the system and identifies components missing that require fabrication.

In addition to the drawings, AGFA obtained a good quality PDF copy of TM 3-350, Gas-proof Shelters, dated 12 May 1943. This manual outlines the M1 and M1A1 Collective Protector systems. It appears the majority of the systems installed at Fort Hancock were M1A1 systems.

The bulk of the work of restoring the Battery Gunnison/New Battery Peck M1A1 Collective Protector was completed as of the spring of 2021. The major work remaining to be done includes sealing the plotting room to create a full overpressure system experience and fabricating and installing the exterior Chemical Warfare air intake system. This work will occur after exterior concrete rehabilitation if Battery Gunnison/New Battery Peck is completed. The work itself will consist of:

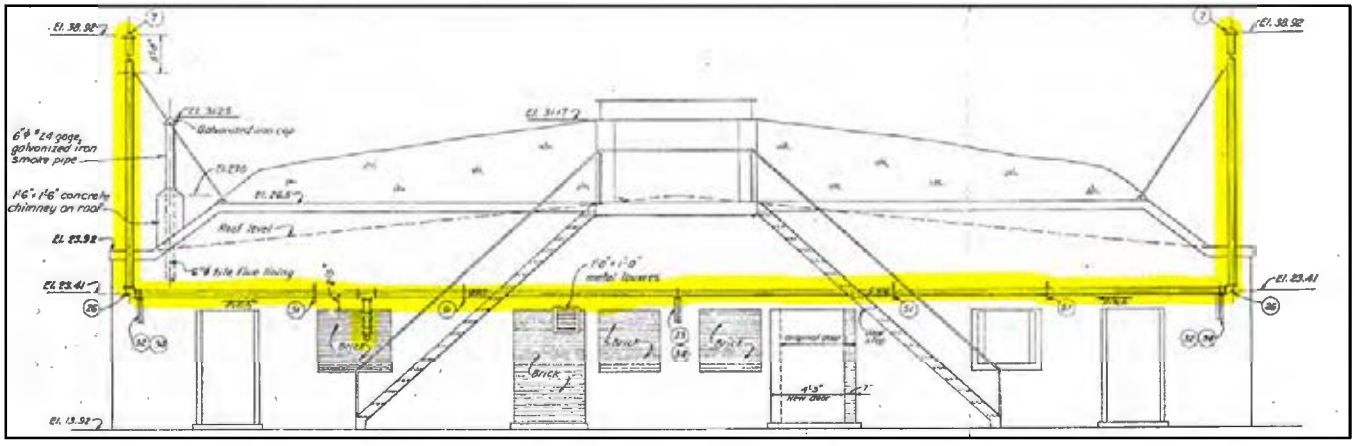
A) Fabricating approximately 60 feet of horizontal pipe that T's into the Chemical Warfare room air filter (inside the room). Much of this pipe has been obtained and is in storage.

B) Fabricate two sections of 15.6 feet vertical air intake pipes with cap tops.

C) Fabricate the suspension system for the two vertical air intake pipes.

D) Obtain three 90 degree elbows and one "T" fixture.

The drawing below is from the 1943 set of "as-built" drawings produced by the Army Corps of Engineers fortifications construction office. The exterior air intake pipes are shown in yellow highlight.



The figure below is from page 41 of TM 3-350 and shows the M1 Collective Protector as a "generic" view. Each system was configured to meet the unique conditions of the fortifications as built. All systems observed at Fort Hancock appear to be the M1A1 type. The primary differences between the M1 and M1A1 are the valves. The system below is operated on Direct Current (DC) and has a rheostat to accommodate DC power operation. All the systems at Fort Hancock were designed to operate on Alternating Current (AC) and did not require a rheostat.

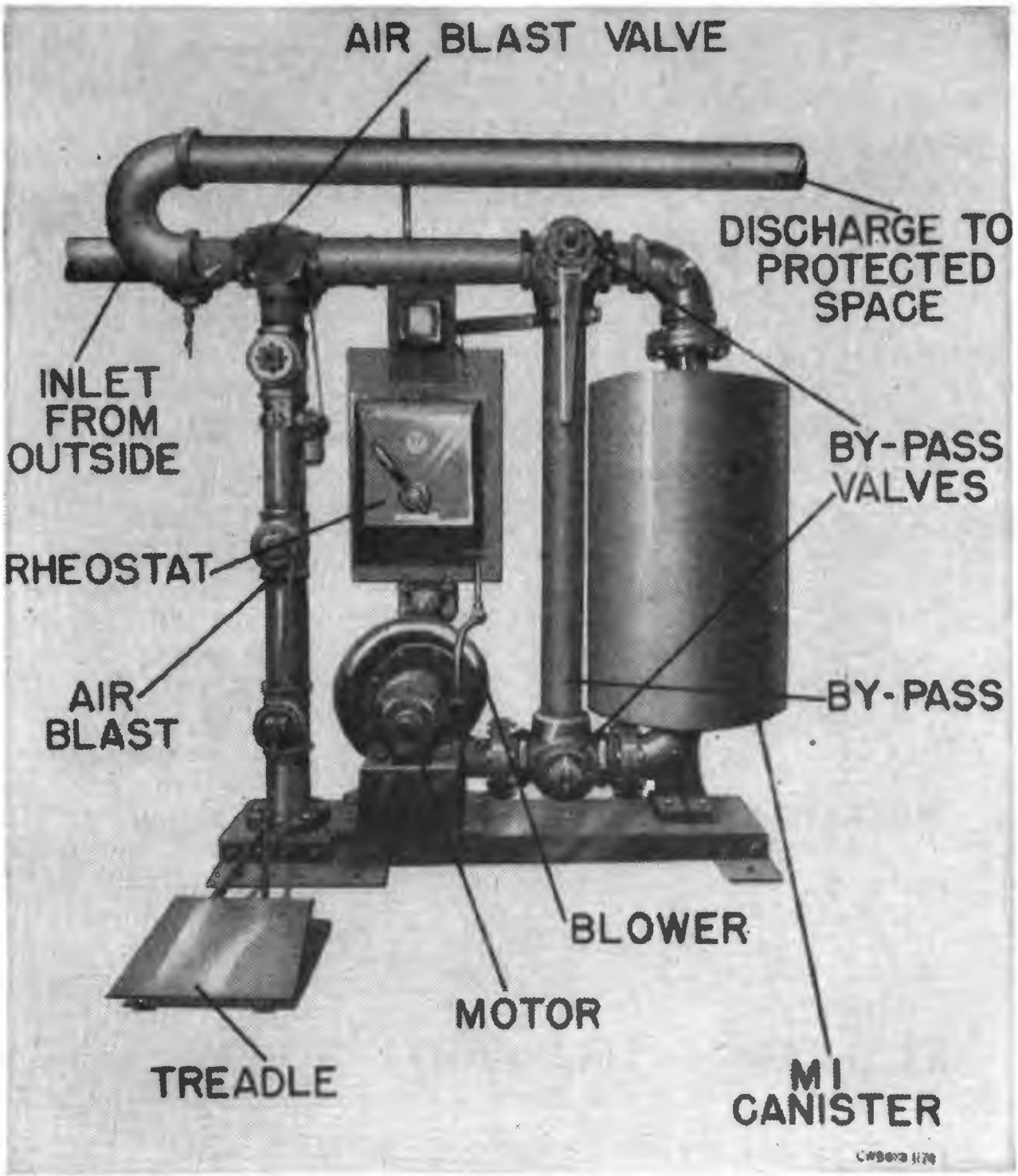


FIGURE 20.—Collective protector M1.

The snapshot below from page 39 of TM 3-350 from May 1943 shows the valves for the M1A1 Collective Protector. These two valves (upper and lower) are unique to the system and are of military design. The upper valve bolts directly onto the M1 Canister Filter. The lower valve is between the M1 filter, the bypass pipe and the blower assembly. The filter is bypassed when the system is used either for "ventilation" or during testing of the air keeping qualities of the protected space.

b. Operational procedure.—(1) Valve adjustments are explained in figure 19.

(2) When the MIA1 protector is used for protection against chemical agents, all windows, ventilators, doors, conduits, etc., within the protected space and the air lock must first be closed. Valves regulating the flow of air through the canister are placed in the position

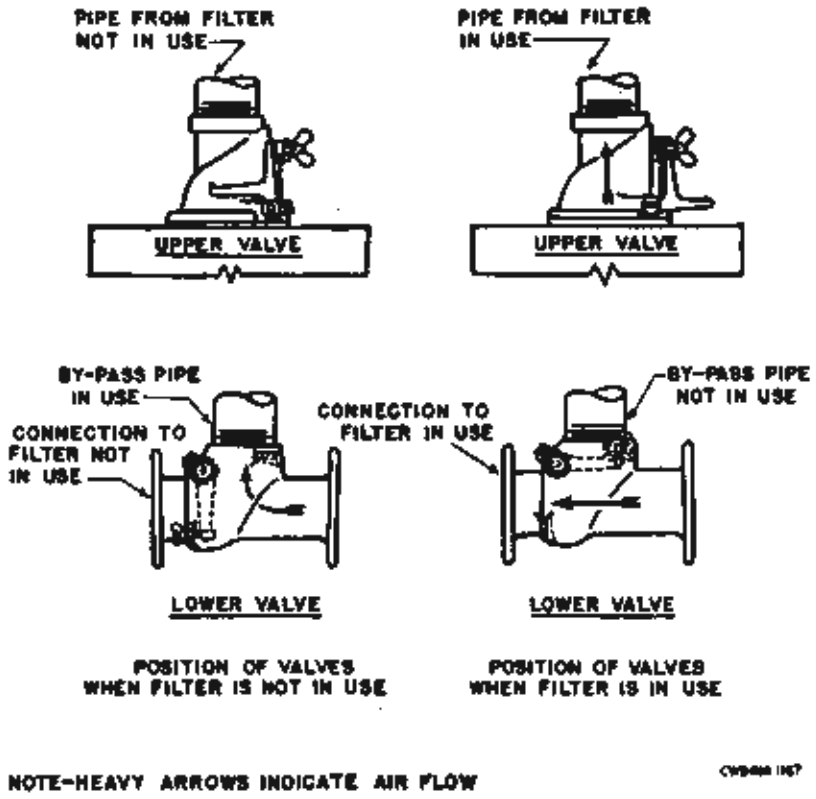


FIGURE 19.—Valve operating diagram for collective protector MIA1.

marked, "When filter is in use." The motor and blower are started with the switch or rheostat, depending upon whether the motor is driven by alternating or direct current. The air pressure relief valves of the protected space are inspected to make certain they will open when pressure within the shelter rises to equal the pressure of ½ inch of water in a manometer.

(3) When the protector is used as a ventilating system, windows, ventilators, and air lock doors are opened as necessary to provide comfort. Valves in the collective protector are placed in the position marked. "When filter is not in use." The blower is started as described in (2) above.

The snapshot below is from page 37 of TM 3-350 and identifies the dimensions of the M1 Canister (filter).

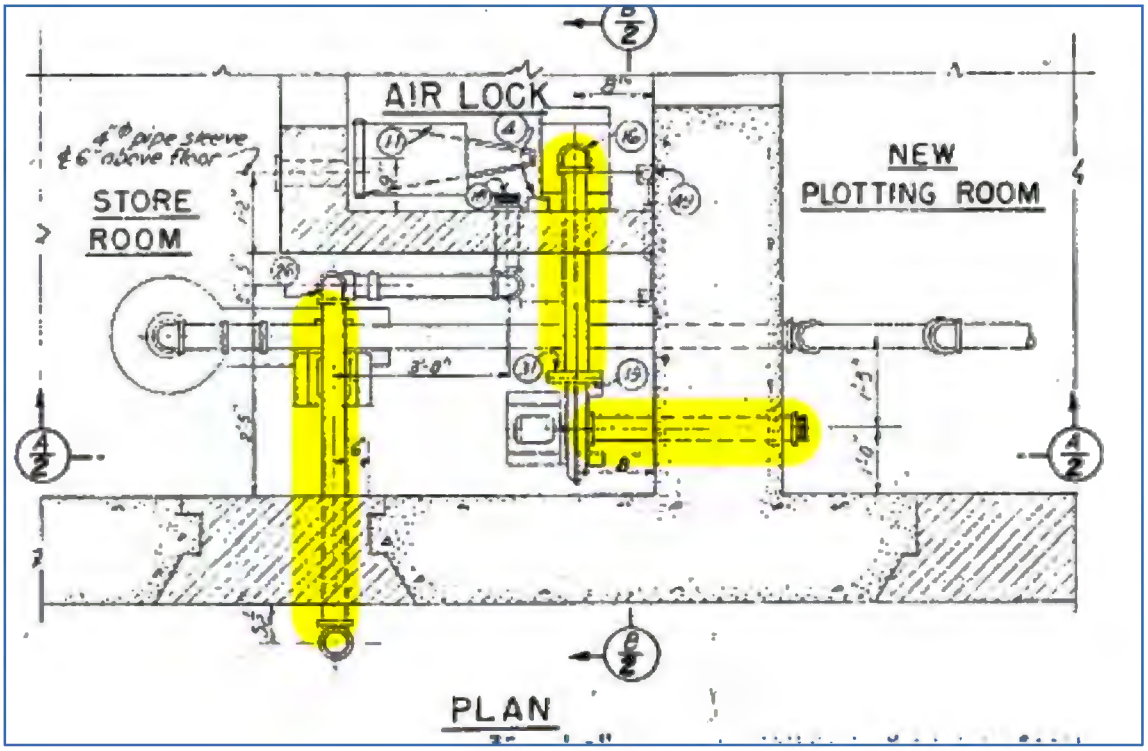
> ***d. Canister.*—The M1 canister is used, which is cylindrical in shape, 39½ inches long by 21 inches in diameter, and weighs 314 pounds. The canister is connected at the bottom by means of an elbow and a gasket to a 4-inch pipe leading to the blower, and at the top by means of a fitting to a 4-inch pipe leading into the protected space.**

AGFA is fabricating a replica filter using a plastic exterior dimension that is approximately 35 inches high and 20 inches in diameter. The top and bottom covers will have a heavy PVC pipe pass through the "filter". The top valve will be secured to the PVC using a flange and seal with an elbow to another pair of mating flanges on the top "T" of 4-inch pipe connected to the by-pass pipe and the main plotting room air distribution pipe.

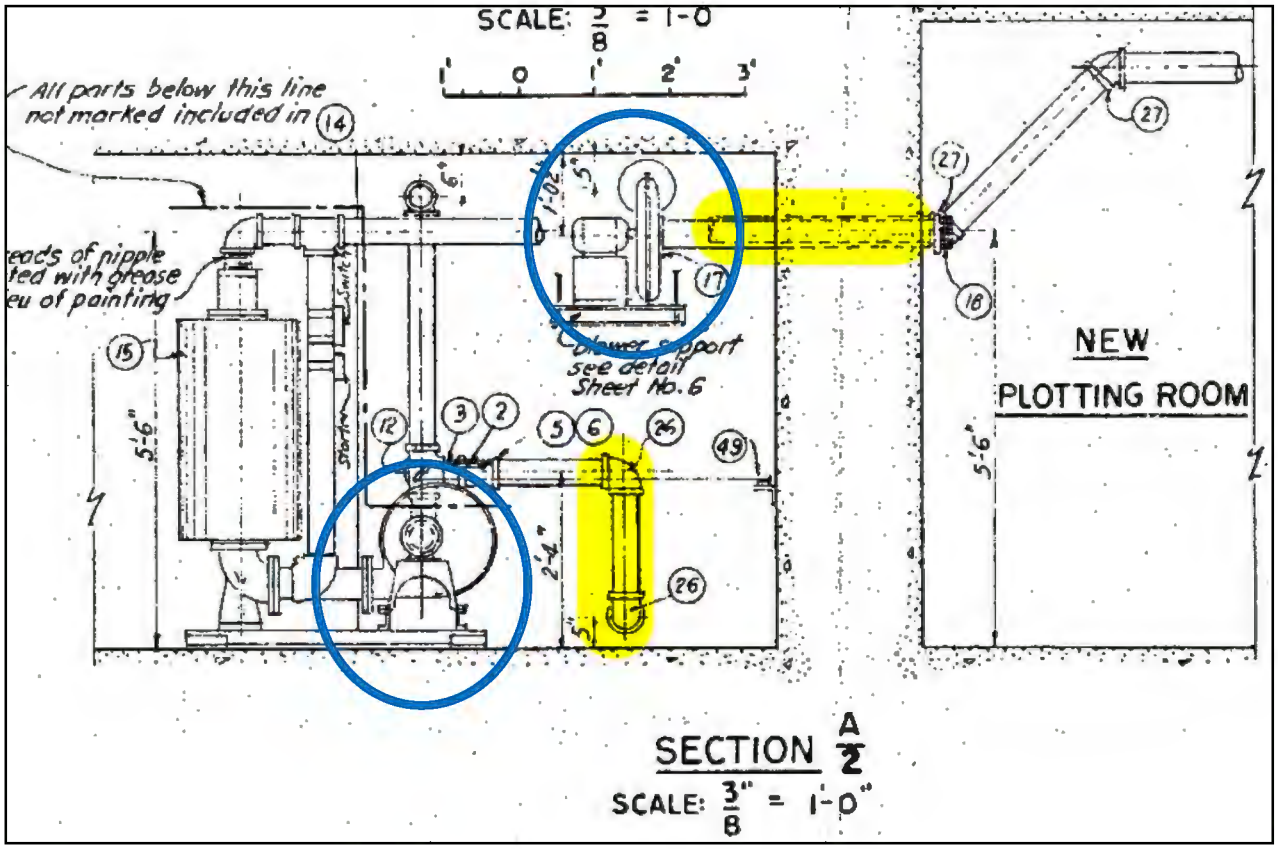
The photo below shows the top bypass filter valve under restoration. This valve is affixed to the top of the M1 Canister Filter and 4-inch cast iron pipe leading to the plotting room (protected space) air delivery pipe and the bypass pipe.

The work to obtain the lower valve and a more intact upper valve is addressed later in this paper.

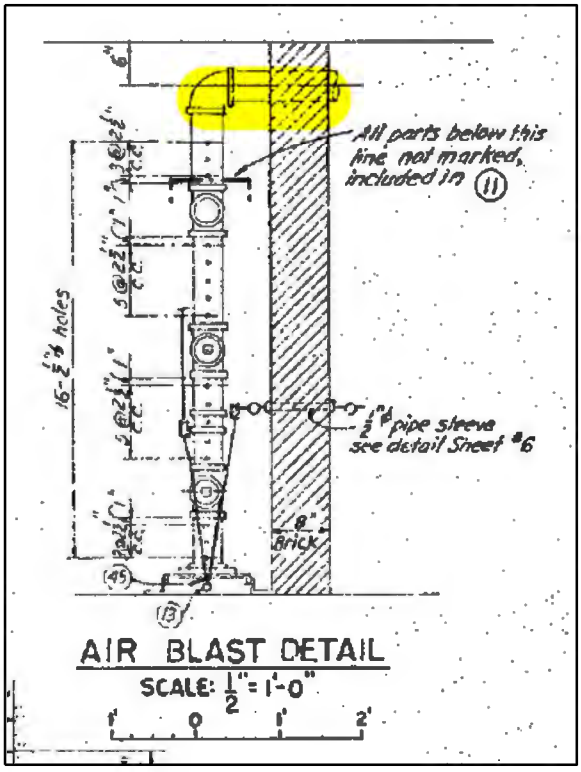
The following drawings show the interior arrangements of the system. The drawing below is a plan view and the pipes highlighted in yellow are what was remaining from the original installation when we started our work.



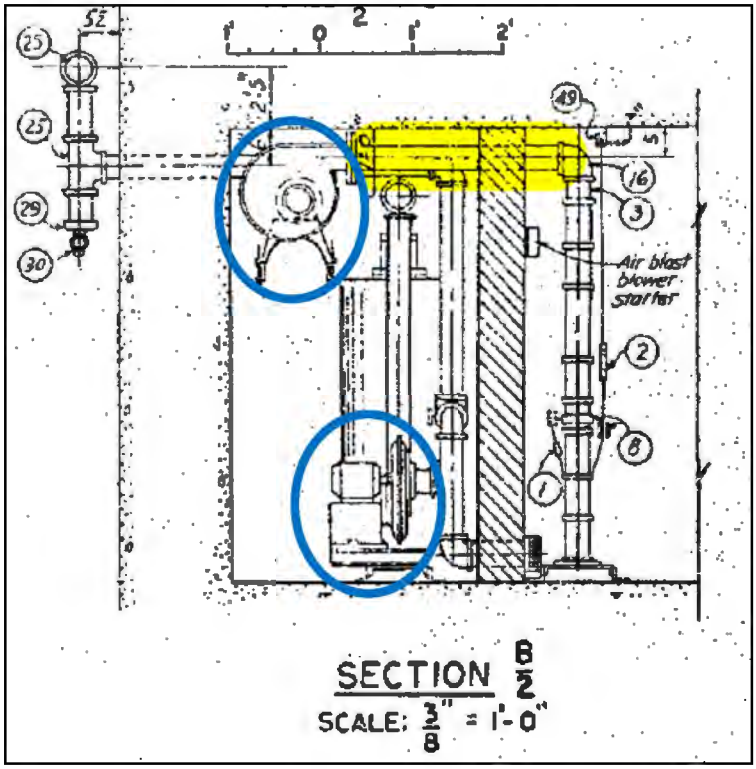
The drawings below show the pipes that remained from the historic installation. The two blowers and motors are shown inside the blue circles. The plotting room piping was installed (PVC) in the 2005-2006 timeframe. We chose light weight PVC to avoid the potential of pipe falling from the ceiling and causing injury.



The drawing below shows the Chemical decontamination stand pipe installation. The yellow highlighted pipe was all that remained from the 1943 installation.



The drawing below shows the original pipe that remained from 1943. The two blowers and motors are circled in blue.



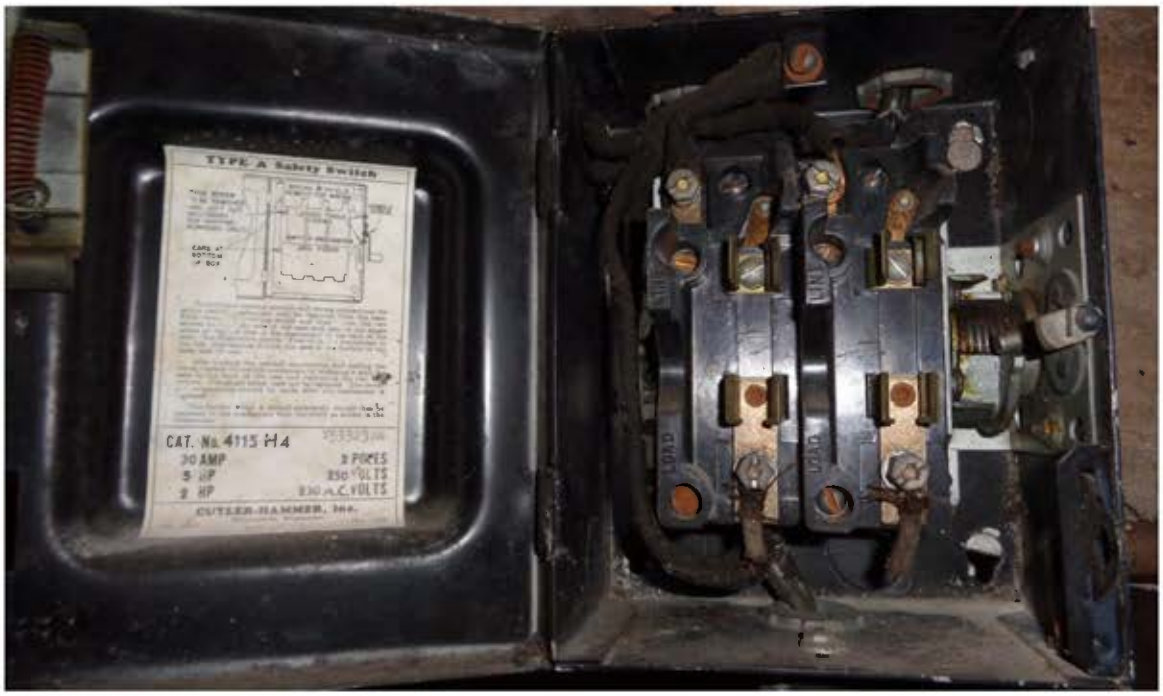
In January 2017 the installation of the switching began with the installation of the two restored pulleys. The picture on the left shows the two pulleys being installed and the picture on the right shows them in position. The heavy joiner assembly on the pipe was an initial installation that proved unworkable and was removed.

In January 2017 AGFA began restoring a significant amount of original chemical warfare equipment obtained from outside of Gateway from a very similar installation. This windfall provided functional switches and controls otherwise unavailable.

The two items below are switch covers and actuators as primed after cleaning.

The two switches, actuating chains and pulleys are shown below in place as of May 2017. The chains shown in the photograph are attached to the treadle on the floor of the decontamination chamber. They are spring loaded on the chain and when the treadle is released, the switches turn off automatically. One switch controls the blower motor, the other controls a red light on the exterior entrance door inside the chemical warfare equipment room. This is the entry point into the plotting room during a chemical agent attack.

Two Type A safety boxes historically were installed with blower motors. None of the boxes on the systems at Fort Hancock have survived. The boxes AGFA obtained are both from 1939 and in near mint condition. The motors are 3,500 revolutions per minute (RPM) Alternating Current (AC) from the 1930s.



In the photo below from May 2017 the Type A box is installed in the lower right. This box controls the decontamination room blower motor. The cables going into the decontamination station in the upper right of the photo go to the switches on the ceiling of the decontamination station. They are actuated by stepping on the treadle on the floor of the decontamination chamber. The conduit penetrating the wall to the left is to the historic 1920s wall light inside the decontamination chamber. The four way box at the top of the picture is from 1920, The one in the center 1940.

The photo below on the left shows the Decontamination room prior to the installation of the stand pipe. The photo on the right shows the assembled stand pipe being installed by AGFA members.

Below the installed standpipe is shown in place on its base. The base had to be fabricated and holes for bolts drilled and taped. This photo shows the standpipe before the treadle and switching assemblies were installed. This work was done in March 2017.

The photo below shows the newly installed treadle plate on the floor of the decontamination chamber. Notice the cable riding on the pulleys to the left and connected to the treadle. In addition to operating the blower motor and the warning light, the treadle also operates a valve on the other side of the wall that changes the direction of the air filter intake from the exterior of the battery to the air scavenging vent protruding from the wall below between the stand pipe and the treadle. The contaminated air from the chamber is then purified in a filter and blown into the plotting room to keep it at proper overpressure and safe during a chemical warfare attack. The pipe has since been primed and painted.

The photo below shows the red warning light (right) signifying that the decontamination chamber is in use. This light was restored and is a 1940 vintage Crouse and Hinds light. The light to the right inside the decontamination chamber is vintage to the 1920s.

The photo on the left shows the entire decontamination chamber system installed. This includes stand pipe, pulleys, switches and their chains, treadle and treadle cables for the valve in the adjacent room. The photo to the right shows an AGFA member on the treadle as he would have stood to actuate the system. Notice the door into the plotting room is closed. Both doors into the decontamination chamber would have been closed during operation as the soldier decontaminated. The assumption was a non-persistent agent such as chlorine or cyanide would have been used. These agents can be blown off of clothing and equipment (theoretically) and exhausted out of the chamber without harm.

In 2016 AGFA located a complete blower and motor assembly. However, the motor was non-functional and required re-winding. The blower assembly was in good condition and easily restored. Most importantly, the impellor fan and closure plate were both in excellent condition.

Installing the blower and motor for the decontamination chamber began in February 2017. The photo below shows the basic condition of the equipment room at the time AGFA began installation of the decontamination blower system.

The blower for the decontamination chamber is suspended on threaded rod from the ceiling. In the photo below the four holes in the ceiling are shown.

Each of the attachment points in the ceiling proved to be usable. They consisted of a large piece of threaded steel. A quick run with a tap and the mounts were ready to receive a threaded rod. A rod is being inserted as a test below.

The decontamination blower housing was installed on 22 February 2017. Below the team adjusts and connects the blower housing to the decontamination pipe.

In the photo below the blower housing is fully installed, awaiting the motor and fan assmbly.

On 9 March 2017 the restored blower cover and fan, along with a 1,750 RPM AC motor and mount were brought to Battery Gunnison/New Battery Peck for installation. This particular motor was chosen because it was easily available and vintage - in this case - 1920s.

The entire assembly weighed over 100 pounds. The easiest way to install was to use a hydrolic lifting table.

The photo below shows the motor, mount and blower cover being mounted on the blower proper. Two threaded rods are already installed.

The photo below shows the blower and 1,750 rpm motor as installed April 2017.

The existing pipe for the exhaust to the decontamination room had been pushed down onto the floor. It had to be raised, which required jacking equipment. Once it was raised, the valve for diverting the exhaust into the filter could be connected.

Below the pipe has been straightened to vertical, an elbow with horizontal pipe, three way valve and a connector to the vertical pipe that leads to the outside air intake. The second blower will be installed to the open end of the three way valve. The cable and spring assembly changes this valve so that it either takes air from the outside or from the decontamination chamber into the air filter.

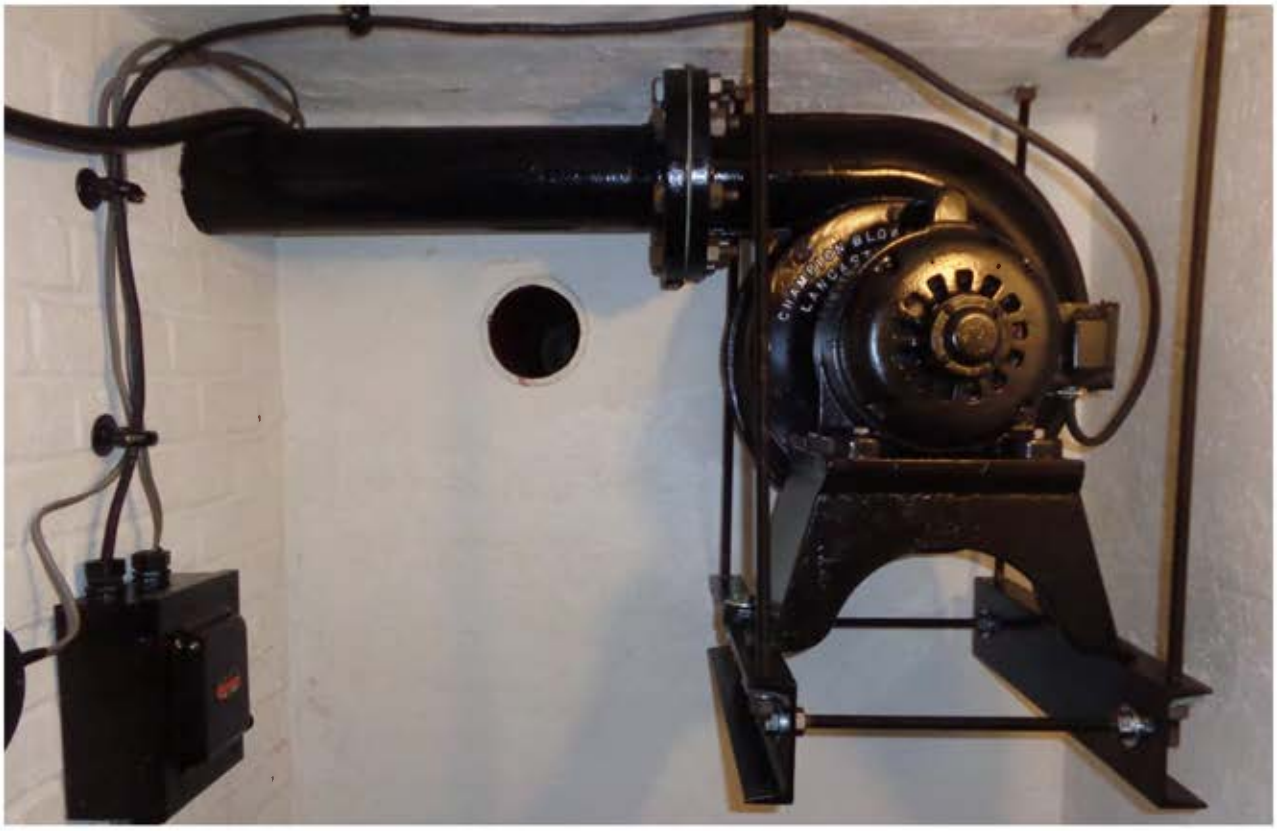
The photo below shows the entire assembly for the decontamination chamber's air valve completed.

The photo below shows the decontamination blower system installed, electrical wiring and pipe horizontal pipe for the air intake to the three way valve. The motor in this instance is the 1,750 RPM motor from the 1920s.

In January 2018, we were approached by the owner of Pilot Electric, Gene Pilot, who offered to restore both 3,500 rpm AC motors as a donation by Pilot Electric of Neptune, NJ (732-775-0121). These motors were returned to AGFA on 29 March. Both of these motors are now mounted within the system of Battery Gunnison/New Battery Peck. The most dramatic restoration is of the motor that was located in the mortar battery (shown below) south decontamination air lock. It was external to the air lock and severely exposed to the elements. Its restoration to working condition was quite unexpected. While the pitting on the exterior is quite extensive, the motor works as designed, and is quiet as well. The entire assembly was installed in Battery Gunnison/New Battery Peck in June 2018.

The first motor AGFA obtained (below) was in relatively good exterior condition. We actually had expected it to work, but, it did not. The inability to operate the motor is what triggered the search for an alternative and the purchase of a working vintage 1,750 RPM AC motor from the 1920s. While the 1,750 RPM motor operates well, it does not deliver the force of air associated with the original motors. Being relatively easy to replace compared to the 3,500 RPM motors, it can be used in more unforgiving locations (like the mortar battery). The 1,750 rpm motor for the decontamination chamber was replaced by the restored 3,500 rpm motor on 26 April 2018.

The photo below shows the restored 3,500 rpm motor in place of the 1,750 rpm motor from the 1920s. This switch occurred on 26 April 2018.



The photo below shows a close up view of the new 3,500 rpm late 1930s motor. This was the motor installed on this blower in the 1940s. It is fully restored with sealed bearings and completely new windings.

Below, the blower and motor assembly removed from the south air lock location in Battery McCook/Reynolds (mortar battery) is shown disassembled prior to rewinding and refinishing the motor. The blower assembly was refurbished. The motor and blower are now mounted inside Battery Gunnison/New Battery Peck.

The photo below taken on 26 April 2018 shows the blower fan blades, closing plate and motor fully restored and awaiting installation to power the overpressure system for the plotting room.

The photo below shows the 3,500 rpm motor (with fan blades) and the blower (upper left corner) prepared for installation on the brass pipe valve. The small motor to the right is the 1,750 rpm motor that was temporarily installed on the decontamination blower. It has been exchanged for the original 3,500 rpm motor and is awaiting installation in the mortar battery north decontamination air lock.

The photo below shows the data plate for the restored motor that will be installed on the blower for the plotting room in the Chemical Warfare room above.

The photo below from June 2018 shows the plotting room overpressure blower and motor mounted to the external air intake pipe and air intake and thee decontamination room exhaust pipe. The pipe from the filter to the plotting room is inserted into the wall sleeve and roped to the air intake pipe above the blower and motor assembly.

The photo below shows the motor and blower proper.

The photo below shows the system, minus the filter assembly and bypass valves, in place in the mechanical niche.

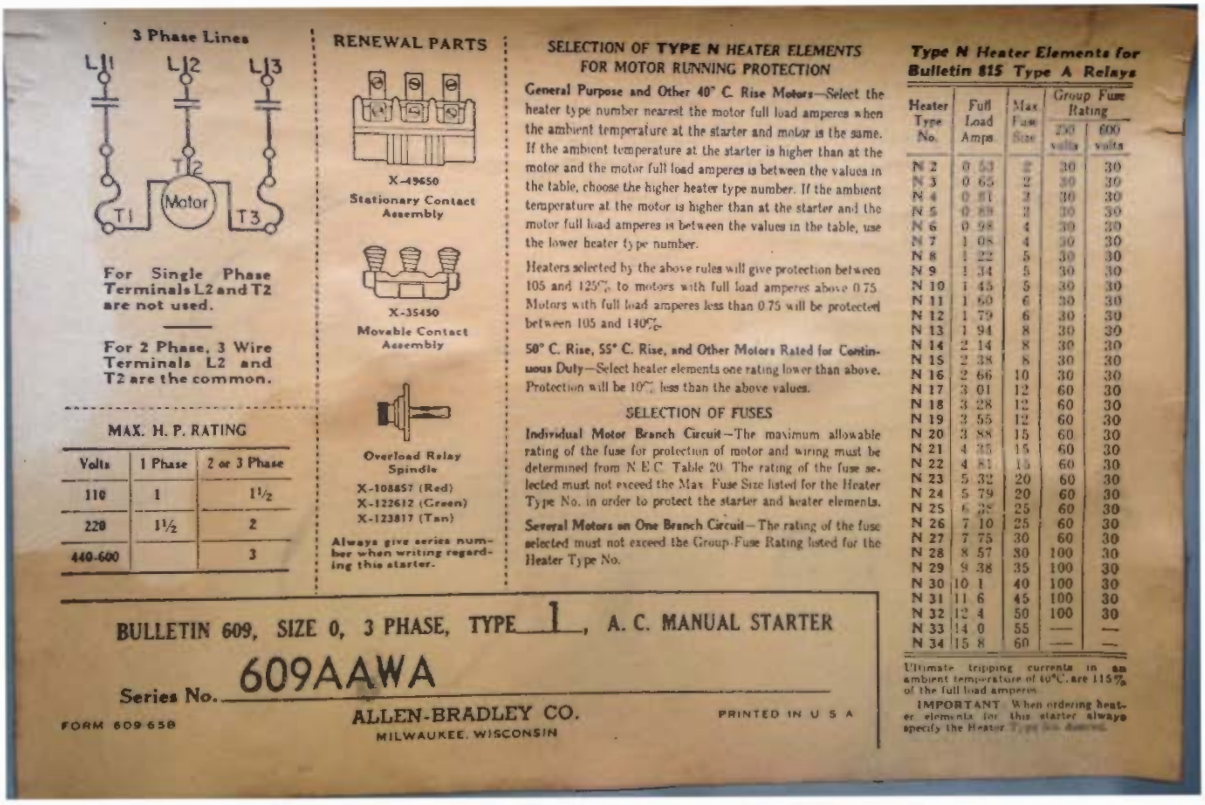
Below are two photos of the Cutler-Hammer Type A safety box for the plotting room over pressure blower motor fully wired and in place. There is a need for a "starter switch" which once procured will be installed at a future date.

Below is a view of both Culter-Hammer Type A Safety Boxes from 28 June 2018. The box on the right controls decontamination blower motor, the box on the left controls the plotting room over pressure blower motor.

The two photos below show the entire installation as of 15 Sept 2018. The cut out switch and the Allen-Bradley starter switch are in place for the Plotting Room over pressure blower motor.

The two photos below show a more complete view of the blower motor Allen-Bradley starter switch, the Cutler-Hammer cut-out switch and a vintage receptacle (hanging on the wall behind the A-B switch).

Basic information on the Allen-Bradley starter switch is shown below. We estimate the manufacturing date for this "new old stock" switch to be mid-1940s.



3 Phase Lines

L1 L2 L3

T1 T2 T3 Motor

For Single Phase Terminals L2 and T2 are not used.

For 2 Phase, 3 Wire Terminals L2 and T2 are the common.

MAX. H. P. RATING

Volts	1 Phase	2 or 3 Phase
110	1	1½
220	1½	2
440-600		3

RENEWAL PARTS

X-49650
Stationary Contact Assembly

X-35450
Movable Contact Assembly

Overload Relay Spindle
X-108857 (Red)
X-122612 (Green)
X-123817 (Tan)

Always give series number when writing regarding this starter.

SELECTION OF TYPE N HEATER ELEMENTS FOR MOTOR RUNNING PROTECTION

General Purpose and Other 40° C. Rise Motors—Select the heater type number nearest the motor full load amperes when the ambient temperature at the starter and motor is the same. If the ambient temperature at the starter is higher than at the motor and the motor full load amperes is between the values in the table, choose the higher heater type number. If the ambient temperature at the motor is higher than at the starter and the motor full load amperes is between the values in the table, use the lower heater type number.

Heaters selected by the above rules will give protection between 105 and 125% to motors with full load amperes above 0.75. Motors with full load amperes less than 0.75 will be protected between 105 and 140%.

50° C. Rise, 55° C. Rise, and Other Motors Rated for Continuous Duty—Select heater elements one rating lower than above. Protection will be 10% less than the above values.

SELECTION OF FUSES

Individual Motor Branch Circuit—The maximum allowable rating of the fuse for protection of motor and wiring must be determined from N.E.C. Table 20. The rating of the fuse selected must not exceed the Max. Fuse Size listed for the Heater Type No. in order to protect the starter and heater elements.

Several Motors on One Branch Circuit—The rating of the fuse selected must not exceed the Group-Fuse Rating listed for the Heater Type No.

Type N Heater Elements for Bulletin 815 Type A Relays

Heater Type No.	Full Load Amps.	Max. Fuse Size	Group Fuse Rating 250 volts	Group Fuse Rating 600 volts
N 2	0.53	2	30	30
N 3	0.65	2	30	30
N 4	0.81	2	30	30
N 5	0.89	3	30	30
N 6	0.98	4	30	30
N 7	1.08	4	30	30
N 8	1.22	5	30	30
N 9	1.34	5	30	30
N 10	1.45	5	30	30
N 11	1.60	6	30	30
N 12	1.79	6	30	30
N 13	1.94	8	30	30
N 14	2.14	8	30	30
N 15	2.38	8	30	30
N 16	2.66	10	30	30
N 17	3.01	12	60	30
N 18	3.28	12	60	30
N 19	3.55	12	60	30
N 20	3.88	15	60	30
N 21	4.35	15	60	30
N 22	4.81	15	60	30
N 23	5.32	20	60	30
N 24	5.79	20	60	30
N 25	6.28	25	60	30
N 26	7.10	25	60	30
N 27	7.75	30	60	30
N 28	8.57	30	100	30
N 29	9.38	35	100	30
N 30	10.1	40	100	30
N 31	11.6	45	100	30
N 32	12.4	50	100	30
N 33	14.0	55	—	—
N 34	15.8	60	—	—

Ultimate tripping currents in an ambient temperature of 40°C. are 115% of the full load amperes.

IMPORTANT—When ordering heater elements for this starter always specify the Heater Type [illegible]

BULLETIN 609, SIZE 0, 3 PHASE, TYPE 1, A. C. MANUAL STARTER

Series No. 609AAWA

FORM 609 658

ALLEN-BRADLEY CO.
MILWAUKEE, WISCONSIN

PRINTED IN U S A

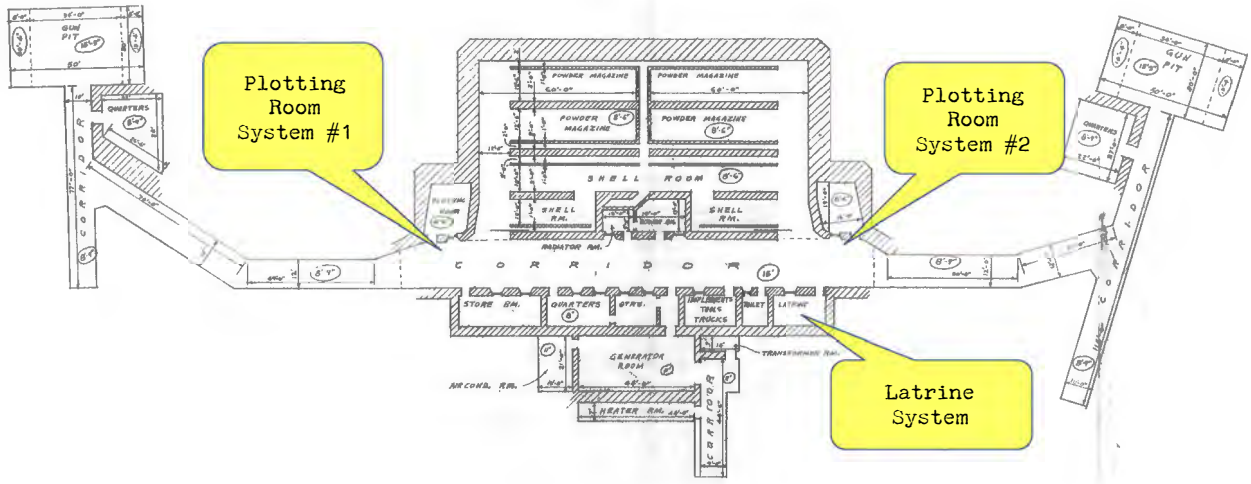
The photo below shows the outside air intake as of 28 June 2018. The inside of the pipe has been cleaned, primed and painted. A stainless steel mesh has been affixed inside the opening to keep the blower from ingesting foreign matter.

The fixture below will be inserted into the air intake hole when the exterior air intake system is installed. This fixture will enable connection of a 90 degree elbow which then connects to a "T" fixture for the two horizontal intake pipes.

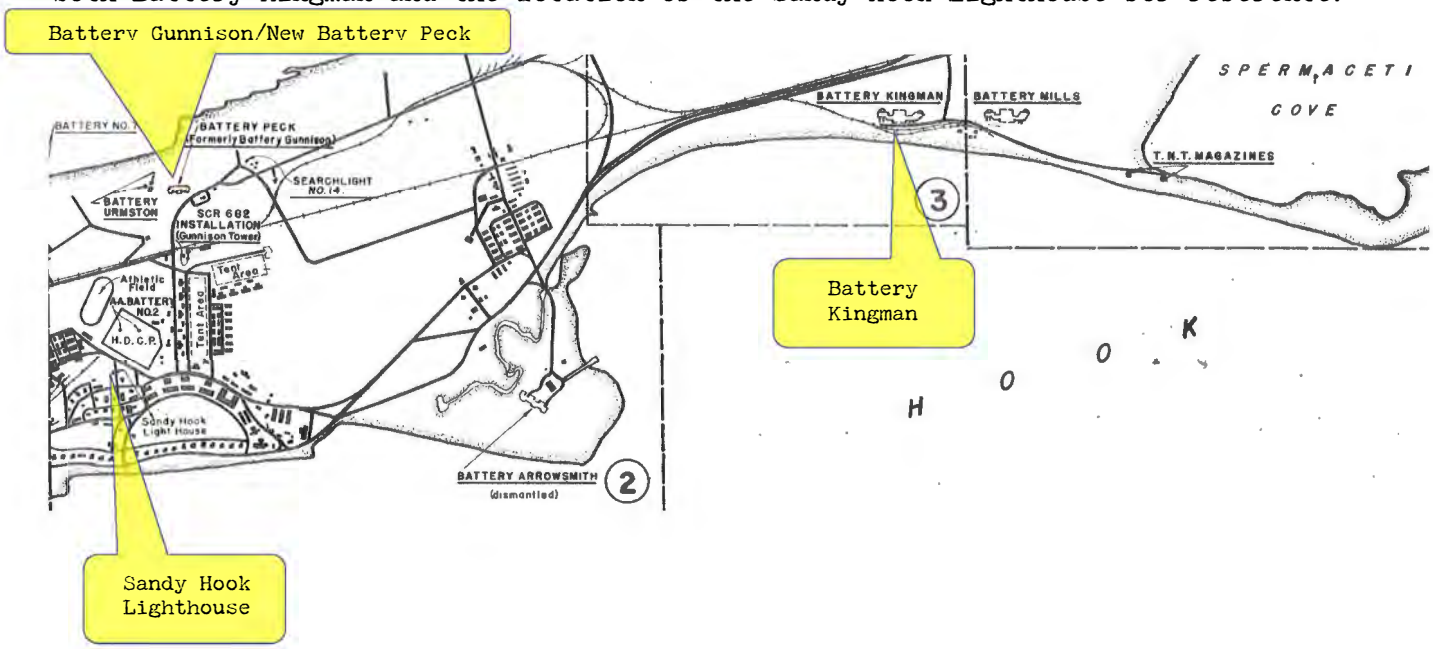
Recovering Chemical Warfare Valves from Battery Kingman

Coordination for recovery of military standard (unique) valves for the M1A1 Collective Protective system began with Pete McCarthy, Sandy Hook Unit Manager, in the spring of 2018. By October 2018, after extensive internal NPS coordination, that the best location to recover an upper and lower filter valve would be Battery Kingman.

The only remaining M1A1 systems at Fort Hancock are in Batteries Kingman and Mills. Each have three M1A1 Collective Protective systems for a total of six systems. All six systems are in advanced stages of decomposition. A system was located at the entrance to Plotting Room #1 which was the manual plotting Room. The next system was located at the entrance to Plotting Room #2 which was equipped with a Gun Data Computer and Data Transmission System. The Latrine had the third system and it had completely collapsed as the result of extensive corrosion. The plotting room #1 system was in the best shape and ultimately chosen for valve recovery.



The map extract below is from the 1944 Fort Hancock area map. The callouts show both Battery Kingman and the location of the Sandy Hook Lighthouse for reference.



The photo below was taken on 6 September and shows the northern M1A1 Collective Protector for the north plotting room (#1) at Battery Kingman. After deliberations between AGFA members, Pete McCarthy and Pete's consultation with other NPS professionals, this unit was selected for valve recovery. The advanced level of decay is very noticeable in the photo below. The grey matter on the floor is the charcoal particles from the filter. Research by the Homeland Defense & Security Information Analysis Center determined that no hazardous materials were used in filters of this model and vintage. The filter composition was comprised of 60 percent charcoal and 40 percent green soda lime.

The basic plan for recovery was to cut the top pipe and lower the entire assembly onto the floor inside the battery. Valve components would then be removed.

Cutting the assembly loose was time consuming. It took a few minutes to make the cut, then to lower the assembly for dismantling. Below AGFA members Wally Tunison and Doug Ciemniecki cut the pipe and Shawn Welch holds the electric light. NPS site manager Pete McCarthy holds the 1936 Army purchased Coleman 220 lantern.

The photo below shows the filter, two valves, and blower assembly on its side. The filter was not connected and quickly rolled to the side.

Below AGFA member Wally Tunison, NPS site manager Pete McCarthy and Ranger Gage review the materials and discuss next steps.

As we prepared to move the assembly to disassemble it, the horizontal pipe connecting the filter to the decontamination chamber collapsed. In the photo AGFA member Wally Tunison removes the broken pipe assembly as AGFA member Doug Ciemniecki looks on.

Below AGFA members begin the process the remove the components of the system. The "grey" charcoal is quite apparent on the floor in this photo. The brown material all over the concrete floor of Battery Kingman is rust from the overhead ammunition service equipment.

The photo below shows the air filter on its side. Most of the casing has disintegrated and the charcoal is no longer contained within the filter.

The view below shows the filtration pipes inside the filter very clearly. The air was pushed into these pipes and then through the charcoal filters surrounding these pipes.

Below the upper valve is being removed from the filter assembly.

The upper valve is shown below - it appears to be in much better condition than the valve we already have on hand for restoration.

Most importantly, a look down inside the valve housing shows the flapper (closure) intact and operational. This is a major achievement and will result in a fully functioning valve set.

The filter support, lower valve and blower housing are shown connected below.

Once relocated outside, the team began the process of removing the blower housing. All the blots and nuts were able to be removed - some by simply applying a wrench and some "elbow grease".

Below shows the blower in final stages of removal.

The lower valve and the filter support are shown below on their way to Battery Gunnison.

The photo below shows the remaining parts on the floor of Battery Kingman. The angle concrete walls are the exterior of the north plotting room's chemical decontamination room. The two pipe holes in the wall are the remnants of two short horizontal air pipes that collapsed during the removal process. All of these remaining components are on the floor in this photo. Most of these components are too far deteriorated to be considered for restoration.

Once all the materials were removed for restoration, the remaining items were stacked back in the corner area where the original filter assembly was located. The photo below shows the filter on end, and the parts to the left of the filter. The grey matter on the floor is the charcoal from the filter and the brown matter on the floor is all flaked rust from the pipe system and the overhead ammunition railings.

As of 13 November, the two valve assemblies are located in the powder passage of Battery Gunnison/New Battery Peck. These items will be cleaned and restored over the next six months.

The next report will add sections on the restored valves and reproduction filter.

Restoration of Chemical Valves and Fittings for Filter

The restoration of the vales began the weekend of 19-20 April 2019. In the picture below the bottom valve and stand (inverted) is being prepared for disassembly.

In the photo below excessive scale and rusted bolts are being removed from the areas around the nuts to the bolts.

The lower valve assembly was separated from the 90 degree stand by cutting the nuts that were rusted onto the bolts. This was a delicate operation to ensure the fixture proper was not marred in any way.

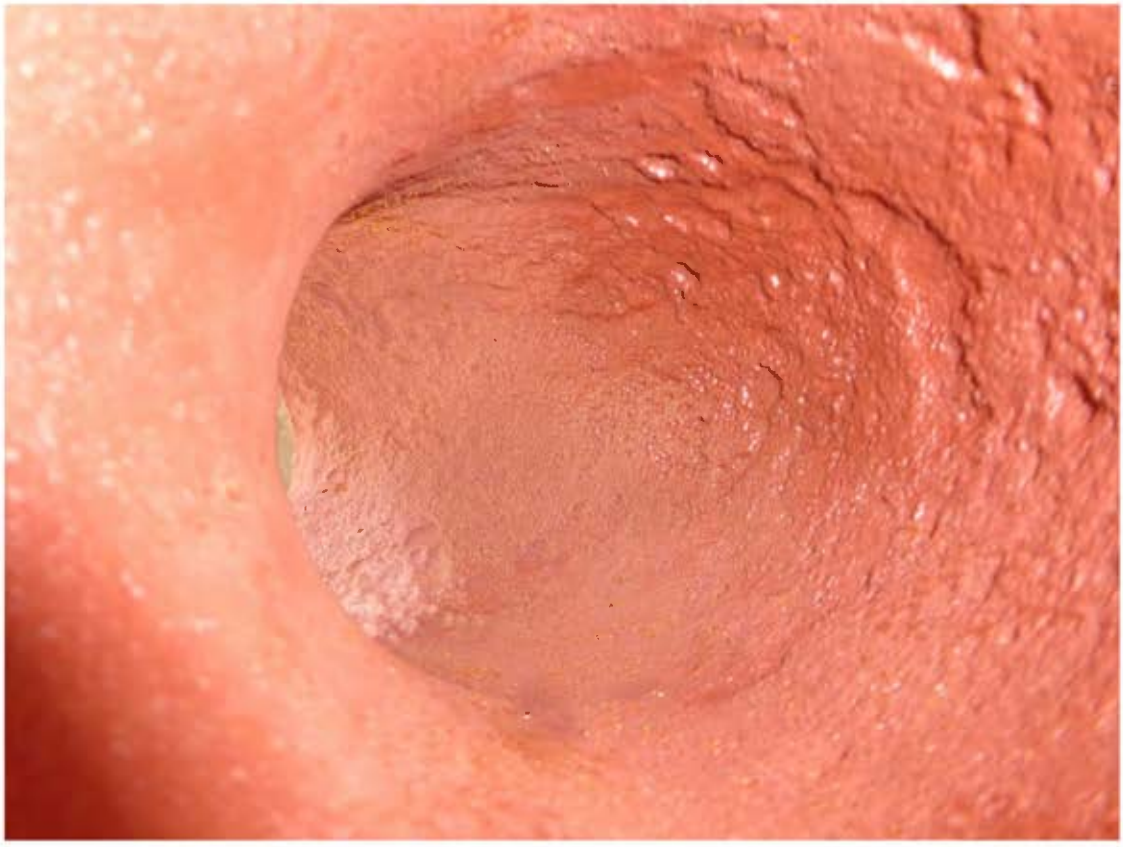
Once the nuts were cut off, the assemblies were separated.

After separation, the threads for the pipe were cleaned as shown below. The silver threads indicated rusted and broken threads were removed.

The photo below shows the inside of the valve with the valve flapper frozen into place. This took several months to gently remove the rust and free the mechanisum.

Throughout the months of May and June, the valve and 90 degree elbow stand were progressively cleaned, taken apart, primed, painted, and reassembled. The photo below shows the 90 degree elbow and filter stand cleaned and primed.

The photo below shows the inside of the elbow with scale and rust cleaned and primed.



In April the upper valve was given an electrolysis rust removal treatment. The valve assembly was frozen solid but after a long soak in penetrating oil it eventually was able to be taken apart. Notice how clean the shaft for the valve arm is. The screw in the lower right of the photo had clean threads, but the head was badly decomposed. The lower valve assembly's retention screw was also badly deteriorated.

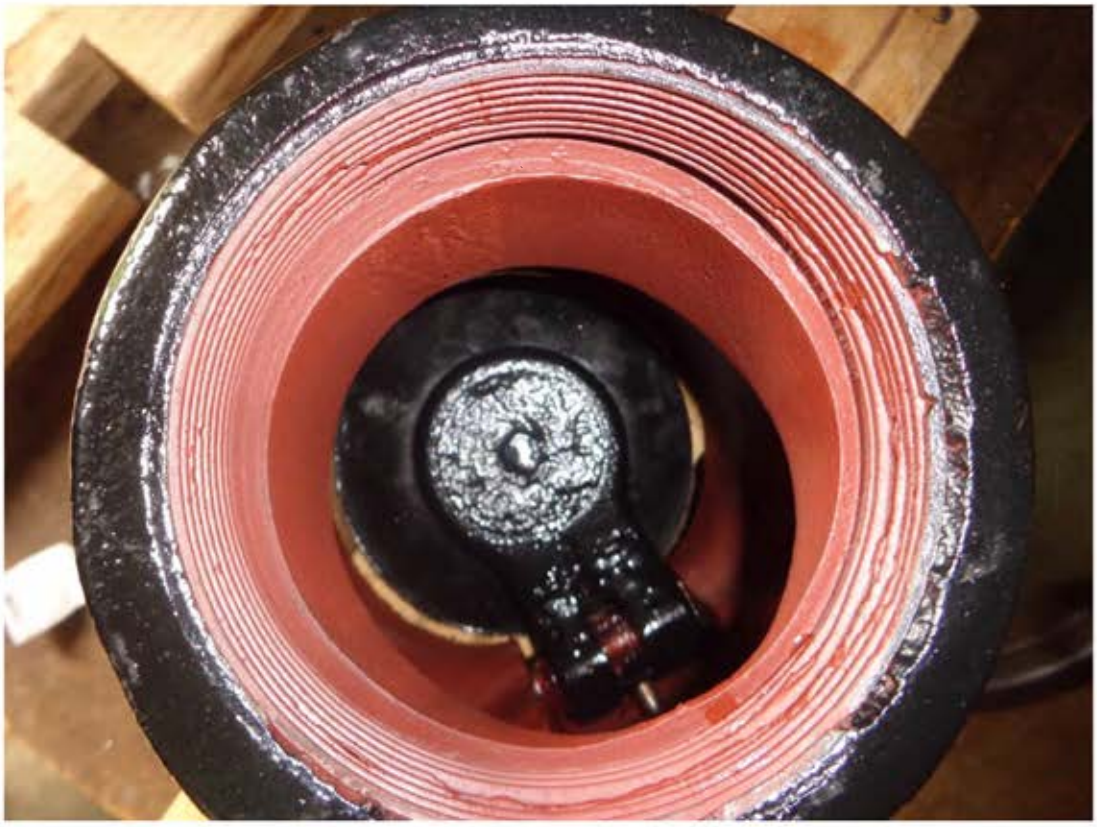
The photo below (left) shows the valve arm actuator assembly reassembled into the valve housing. Notice the badly damaged screw head in the lower left on the valve assembly. That same screw is shown in the photo on the right.

The answer to badly deteriorated screws was to make new screws. The two screws on the left below are replacements for the badly deteriorated screw shown on the right. These screws were made on site in the Machineshop at Battery Gunnison/New Battery Peck. The photo on the right shows the final measurements being taken on one of the new screws in the Battery Machine Shop. The lathe where the screws were cut to size is in the right of the picture. These screws are critical to the correct functioning of the valves. Without these screws, the flappers are not held in place which prevents the seal from being achieved.

The photo below provides another view of the top valve. Notice the large butterfly screw - a custom made screw to replace the badly decomposed original. The valve housing required the aggressive cleaning and re-threading of the top pipe threads.

The Upper Valve is shown below with the valve flapper open from the top looking down.

The photo below shows the upper valve flapper closed from the top looking down.



The photo below shows the upper valve with the flapper open looking from the bottom (filter) side looking "up" into the outflow pipe.

The photo below shows the flapper closed as it would be on the opening into the filter assembly.

In September 2019 we began the process of installing the second half of the mounting platform. The photo below shows the 90 degree platform resting on the platform plate assembled to the motor/blower plate. The black elbow will be removed and the lower valve assembly will be put its place and connected to all three - blower, vertical pipe and 90 degree elbow

The photo below shows another view of the platform and the 90 degree elbow.

The lower valve was also under restoration. The photo below from 14 Sept 2019 shows the lower valve with the valve arm open.

In the photo below the valve arm is shown in the closed position.

The photo below shows the valve (before final restoration) in the closed position. The rubber flapper is missing at this stage of restoration. Notice the heavy scaling and rust inside the pipe.

The photo below shows the valve fully opened into its recess.

The lower valve assembly pictures below show the parts of the valve actuator removed (left) and assembled (right). The broken hinge part on the flapper was welded back into place and the entire assembly is reassembled (right picture).

The badly deteriorated screw head on the lower valve is shown below. That screw was replaced by one of the newly made screws shown earlier on page 46.

In February 2020 the lower valve assembly was completed. The photo below shows the valve from the underside.

The photo below shows the lower valve from the top looking down with the flapper in the "closed" position for the "bypass" pipe. This would actually put air through the filter. To the upper right of the photo are two 1915 Corps of Engineers Standard light switches. These electrical boxes contain ceramic single pole "snap switches". The switch handles were fabricated in the machine shop at Battery Gunnison/New Battery Peck.

The initial fitting took a lot of effort. Below a shaft is used to lift the assembly and determine if a seal can be achieved. PVT Budjos, CPT(CH) Uhler and T-4 Ciemniecki are busy positioning the assembly below.

After additional work, it was determined the bypass pipe had to be shortened.

The photo below shows the lower valve assembled to the blower (left) and the 90 degree elbow. The filter will be bolted to the top of the 90 degree elbow.

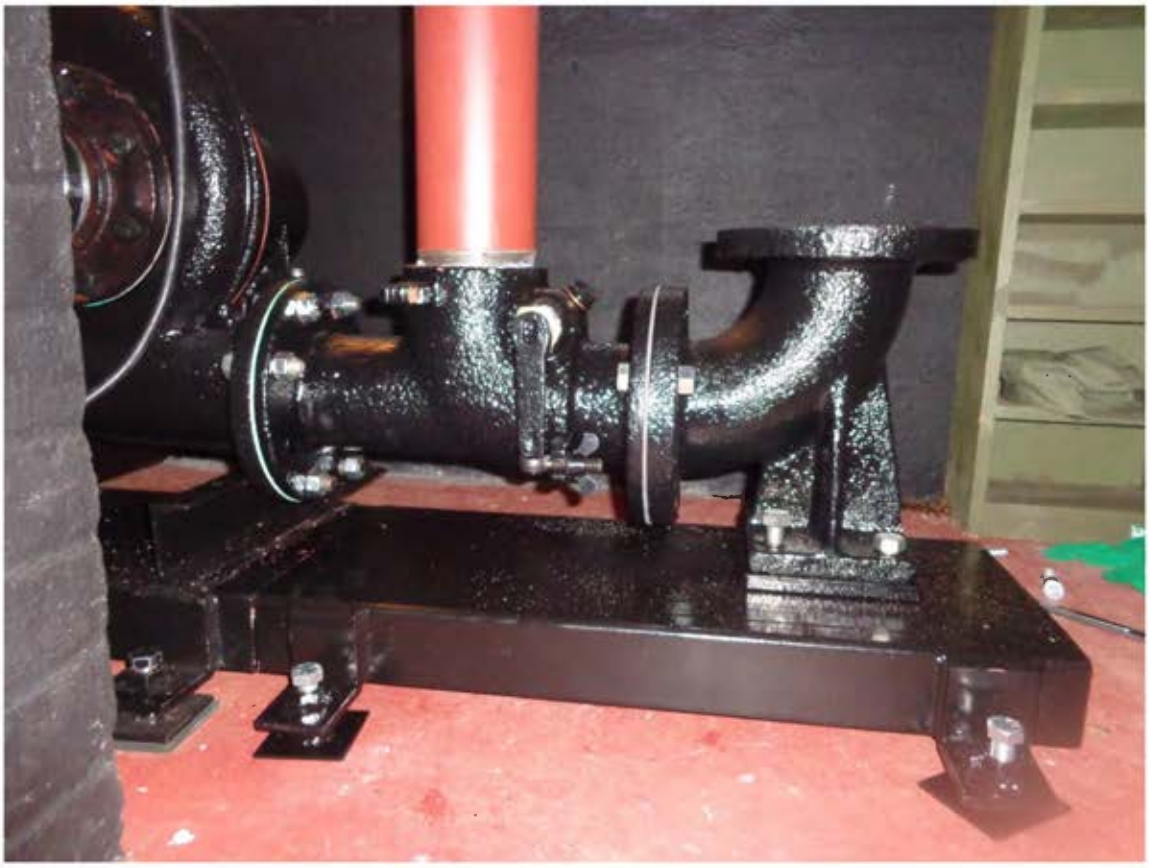
The photo below shows the lower valve with the upper valve sitting on top of the 90 degree elbow. The filter would be situated between the upper valve and the 90 degree elbow.

The new bypass pipe was then assembled to the lower valve and this required significant muscle power and several personnel to get it straight.

Below the team continues to seat the lower valve and the bypass pipe.

The two photos below show final seating of the lower valve and installing the bolts and seals.

The photo below shows the lower valve in place, secured to the blower, bypass pipe and 90 degree elbow. The lower platform is seated in place with the 90 degree bypass valve bolted into place.



The two photos below show T-4 Ciemniecki as he fits the upper valve in place and taking measurements to confirm distances between the upper and lower valves.

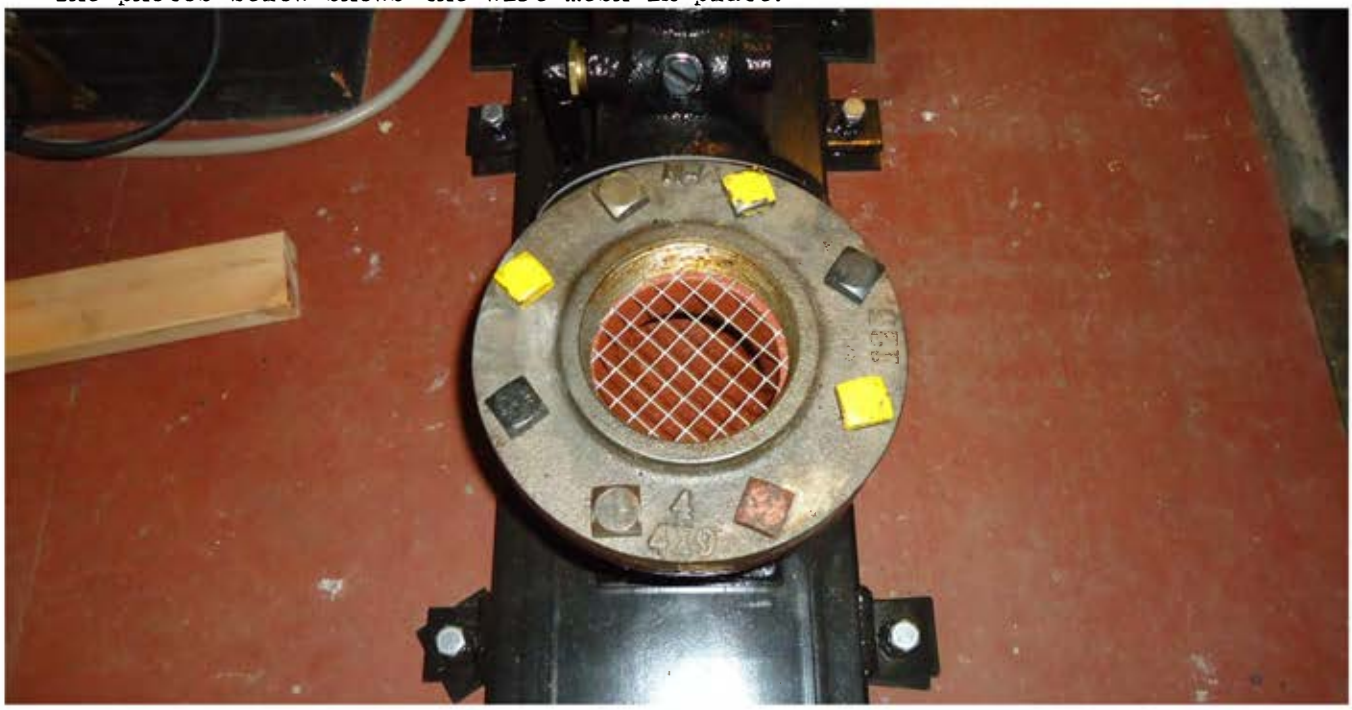
The photo below shows a clearer view of the upper valve in place.

The photo below shows the upper valve in its proper orientation with a flange installed on the base of the valve and a plug fitted into the flange.

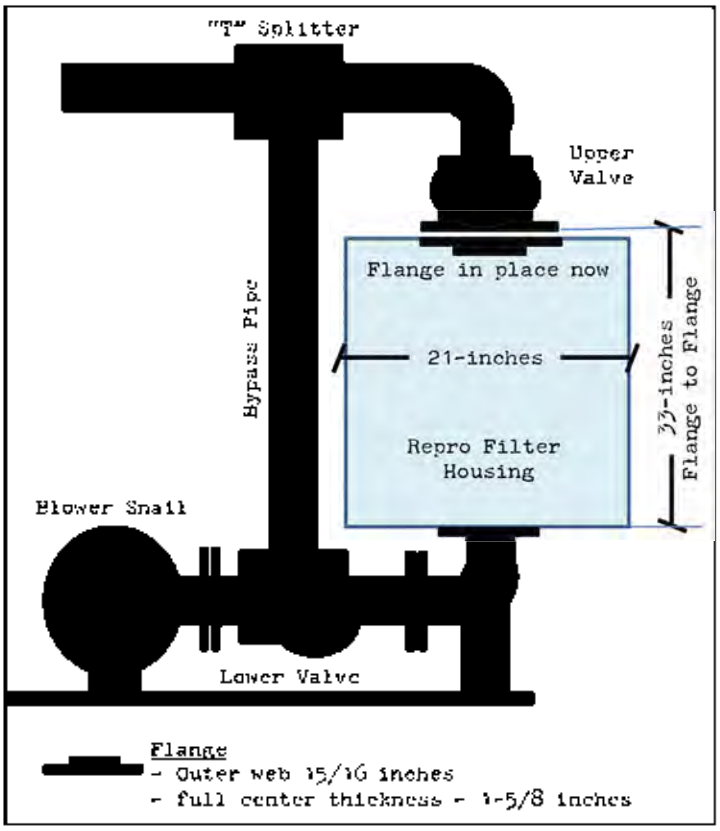
The photos below show the upper valve with the plug removed from the flange. The photo on the left shows the valve "closed" (black rubber sealer in place) and the photo on the right with the valve "open" to see the primed interior of the pipe. With the flange in place, the valve works to restrict airflow and close off the opening. This enables a physical experience of moving air to demonstrate the use of the valve when switching from the bypass pipe to the filter proper.

The photo below shows the Lower valve and the 90 degree pipe in its proper orientation with a flange installed on the top of the 90 degree pipe. A section of wire mesh was secured between the flange and the top of the 90 degree pipe to keep objects from falling into the pipe and damaging either the blower or the valve.

The photos below shows the wire mesh in place.



The last major component of the M1 Collective Protector is the Filter proper. A drawing of the protector and the filter location is shown below.



To install a filter (or reproduction filter), the assembly must be designed to secure to the upper and lower flanges by means of bolts. The filter should not have an top or bottom seam that is higher than the top or bottom plates of the filter. A gasket would seal air flow. The filter should be no wider in diameter than 21 inches. The filters should be no taller than 33 inches. The lower valve flange is the controlling start point for measurement. The upper valve nipple is seated (threaded) as far into the upper 90 degree elbow as the threads allow the valve to face in the proper orientation. This position allows for 33-inches between flanges. There is approximately half an inch of adjustment to 32-1/2 inches by backing out the upper valve nipple from the 90 degree fitting.

The interpretive concept for the filter requires the public to obtain a tangible experience from operating the valves to direct contaminated air into the filter.

The difficulty in developing an ability to get a physical experience from the filter and the additional access problems the filter would create for access to the electrical components of the system resulted in a revision to the plan. The team decided against fabricating and installing a reproduction filter assembly once an original filter from Battery Mills was obtained and became available for interpretive use.

In 2020 AGFA obtained an original M1 Collective Protector filter from Battery Mills. This filter in a deteriorated state enables one to see to inside structure - providing a significantly improved visual interpretive experience.

Keeping the two valves open and accessible enables a sensation of moving air to achieve a physical experience and allows much easier access to the electrical components of the system.

Beginning in April 2021, T5 Morrison designed and began building a display case for the filter. As the filter insignificantly deteriorated, it is inappropriate to place it in use with an active system. But its deteriorated state provides significant opportunity to explain how the filter works and see its otherwise unavailable interior construction.

The photo below shows the deteriorated filter as recovered from Battery Mills. Notice the red bucket to the lower right and the black "dust" at the bottom of the filter. This is the actual charcoal filter material leaking out of the deteriorated canister.

The display case design is two sides of hard wood, and two sides and top of clear Plexiglas. The inside wooden portion will be painted bright white to improve visibility. The case will be on casters, with two handles on reinforced boards to enable easy relocation within the Battery as needed. The case will be sealed so none of the loose charcoal can leak from the case.

In the photo below T-5 Morrison is attaching the large casters to the bottom of the display case.

The partially completed case is shown below on its casters.

The interior of the case was painted gloss white on 18 April 2021 as shown below.

The photo below shows the filter proper inside the case after painting. Notice the charcoal powder at the bottom of the filter case.

The next step for the case was fitting the 3/8-inch Plexiglas to the case. This work started on 7 May 2021.

The photo below shows the filter with the two Plexiglas sides in place.

The photo below shows T-5 Morrison fitting the Plexiglas sides onto the case.

On 11 June 2021 CPL Cusano began the process of filtering all the foreign materials out of the charcoal and preparing it for display.

Below CPL Cusano finishes filtering the charcoal (left) and then placed it inside a display cube (right).

The original display cube was too tall and left a large void area. T-5 Morrison cut the cube into half its original height and then glued it in place. In the photo below the glue is setting. This will seal the cube and prevent charcoal from escaping the container cube.

The next step was to secure the movement handles to the wooden sides of the display case. The photo below from 23 July 2021 shows the handles in place on the reinforcing boards on the sides of the case.

The photo below from October 2021 shows the final glue setting to seal the case.

The photo below shows the case completed with a top cover to prevent scratching the plexiglass surface.

Another view of the case - it is now ready to use for interpretation.

The only remaining work to be done on the M1A1 Collective Protector is the exterior air pipes. Those will be completed after the concrete restoration project is finished in the 2025 timeframe.