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EXTRACT FROM OPERATING MANUAL (OM-16)
BUILDING AND BUILDING UTILITIES VOLUME IX

Compiled by
S. G. Thornton
Environmental Management Division
OAK RIDGE K-25 SITE
for the Health Studies Agreement

October 2, 1995

Oak Ridge K-25 Site
Oak Ridge, Tennessee 37831-7314
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UNCLASSIFIED

OM-16

OPERATING MANUAL

BUILDING
&
BUILDING UTILITIES

VOLUME IX

K-25

OM-16

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II. BUILDING UTILITIES

The utilities of the process buildings are considered to consist of the following:

Ventilation System
Heating System
Building Lighting
Communications System
Stage Handling Equipment

1. Ventilation System

The prime object of ventilation in the process buildings is the dissipation of heat as the air circulation is greatly in excess of breathing requirements. This heat is generated in transformer windings, motor windings, lights, and from solar heat through the roof, with the main source of heat coming from within the cells. The coolant system has a rated capacity to carry off the total heat of adiabatic compression, but the pump casings, converters, and connected piping will run sufficiently hot to liberate large quantities of heat which must be removed.

There are two principal requirements to be met by the ventilating system which are as follows: **DESIGN REQUIREMENTS**

(1) Removal of sufficient heat under maximum summer temperature conditions to maintain within the cells the stipulated temperature of the process material, and to maintain a temperature outside the cells in the alleys and the operating floor that can be tolerated by the operating crew.

(2) To retain within the buildings as much heat as possible under extreme winter conditions, or all that is desirable during spring and fall, and still maintain the stipulated temperature within the cells.

It has been found that the first of the above conditions is the more difficult to meet, and all calculations of air quantity have been made on that basis. The maximum assumed average condition of atmospheric air has been taken at 95°F. and 70% relative humidity.

The general design calls for the circulation of an ample quantity of air over the warmer component parts. This air will absorb heat and be discharged through ventilators in the roof. It should be pointed out here, that the basement is well sealed from the converter floor. The motor alley and space over the cells is sealed from the pipe gallery floor and withdrawal alleys. The operating floor seals the operating room from the rest of the building.

It is possible to get an air flow between these different sections by opening dampers and louvres. The operation and location of these will be mentioned as they apply to the ventilation requirements.

The ventilating system is really comprised of three systems:

(1) Cell ambient air ventilation

(2) Operating floor ventilation

(3) Transformer vault ventilation

Each of these systems will be discussed separately.

All of the air entering the ventilating systems must be filtered. The same filters are used by systems (1) and (2), above. The transformer vaults have separate filter systems.

Air Filtering System

The air supply for the cell and operating floor ventilating systems enters at the rear of each building through two penthouses which house the filters. Air enters the penthouses through louvred openings, passes through a screened filter bank and then to the suction of the fans.

The filter bank consists of a number of frames each composed of several 20" x 20" units. Two 20" x 20" x 1" filter cartridges fit into each unit in series. Figure II.1-1 shows the filter arrangement. The zig-zag pattern of the banks allows for a greater filter area.

The filter cartridges were supplied by Owens-Corning Fiber-Glass Corporation and Research Products Corporation. The Owens-Corning filters are constructed of interlaced glass fibers in a grille frame. The Research Products filter consists of a paper filter pad sandwiched between two wire grids. These filters are completely interchangeable. However, it is desirable, for the sake of uniformity, that only one type be used in any given building.

MAINTENANCE

These filters should be regularly inspected in order that they do not become too dirty. From time to time, depending on the amount of dust in the air, they should be cleaned, and, if necessary, replaced. Filters that are clogged and dirty are inefficient, may present a fire hazard, and may cause the blower motors to overheat. Vendor's bulletins attached, show methods of cleaning and maintenance for these filters.

When the intake filter becomes too dirty to be cleaned, it should be discarded and the Number 2 filter moved up into its place. The new filter is then installed in the Number 2 position, behind intake filter.

The transformer vault ventilating systems have separate filter chambers. The same filter units and cartridges are used as for the buildings. There are two filter chambers for each vault, The filters are arranged in the form of an inverted "V". Hinges at the top permit the filters to swing to a vertical position for cleaning and replacement.

The transformer vault extensions have a separate small filter chamber on the side of the extension.

The arrangement of transformer vault and extension filter chambers is shown on Figure II.1-2.

Cell Ventilating System

The cell ventilating system performs a dual job.

(1) It helps maintain the correct ambient temperature within the cell as required by the process.

(2) It provides for keeping the motor alley and withdrawal alley air at a temperature suitable for the operating crew.

FANS

Atmospheric air goes through the filters and to the suction of the cell ventilating fans. These fans are located in the basement, one under each cell for all buildings except those in Section 4, which contain two rows of three fans each for the fourteen cells. The cell ventilating fans may be Buffalo Forge, B.F. Sturtevant, or American Blower Company, depending upon the section. Table II.1-1 lists a schedule showing operating characteristics of the various cell ventilating fans. Figure II.1-3 shows a drawing of the Buffalo Forge fans used, with a table of sizes, followed by performance curves for the various sizes of fans, Figures II.1-4 to II.1-7, inclusive. Figure II.1-8 shows the B.F. Sturtevant fans, and Figures II.1-9 and II.1-10 show performance curves. Similiarly, Figure II.1-11 is a drawing of American Blower Company fans and Figure II.1-12 is a performance curve for these fans.

As indicated on Table II.1-1, and similiar tables which follow for operating floor and transformer vault ventilating fans, there are speed variations, even among fans of the same make and size. Each speed variation would result in a proportionate increase or decrease in the performance curves for that type of fan.

[redacted]

SCHEDULE FOR CONVERTER CELL

FLOOR VENTILATING FANS

TABLE II. 1-1

	311-1	310 307	309 301	303	304	305	K306
GROUP	-3	-2, 2A	-1, 1	2B	3A	3B	4
NAME OF MAKER	BUFFALO FORGE	BUFFALO FORGE	BUFFALO FORGE	B.F. STURTEVANT	BUFFALO FORGE	AMERICAN BLOWER	BUFFALO FORGE
NO. OF FANS	10	70	56	94	50	120	36
TYPE FAN	#5 1/2 "LL"	#6 "LL"	#6 "LL"	DESIGN 7 #90 SILENT-VANE	#5 1/2 "LL"	#5 1/2	#6 "LL"
CFM	17,000	24,000	23,500	18,500	17,500	16,000	20,000
RPM	1103	1066	1066	975	1148	1220	1215
STATIC PRESSURE @ 95°F. & 70% RH	3.33"	3.33"	3.45"	3.5"	3.65"	3.5"	3.62"
BHP @ 95°F. & 70% RH	12.92	19.55	19.4	13.3	14.5	12.5	16.08
LIM. HP @ 95°F. & 70% RH			20.3	14.2		13.2	17.62
OUTLET VELOCITY FT/MIN.	2720	3140	3080	2600	2500	2667	2355
STATIC EFF.	68.6%	64.2%	65.5%	71.5%	69.2%		70.7%
TIP SPEED FT/MIN.	9540	10,170	10,170		9900		9700
MAX. SAFE SPEED RPM	1215	1100	1100		1220		1100

[redacted]

MOTOR HP	15	20	20	15	15	15	20
MOTOR RPM	1745	1760	1760	1800	1800	1745	1740
MOTOR FRAME	326	364	364		326	326	364
BELT HP		27	27		19	19.5	24.5
WEIGHT UNIT LBS.	1490	1870	1870		1610	920	1920
MOTOR MAKE	WESTING-HOUSE	WESTING-HOUSE	WESTING-HOUSE	G. E.	WESTING-HOUSE	WESTING-HOUSE	WESTING-HOUSE

[redacted]

Because of space limitations, performance curves for only one speed of each size and type of fan have been included. The attached tables, however, list maximum quantities for all fans. If additional information is required for any fan running at a speed for which no performance curve is listed, it may be interpolated from the performance curve shown for that size of fan. The CFM output is directly proportional to the fan RPM, the static pressure is proportional to the square of the RPM, and the horsepower required is proportional to the cube of the RPM. Thus, the characteristics of a fan at any speed may be determined.

FAN SPECIFICATIONS

Each of the fans shall have the capacity to discharge into its duct system the cubic feet of air per minute specified in Table II.1-1, under maximum summer intake conditions of 95°F. and 70% relative humidity. The fans will receive air from the basement of a building or buildings to which air flows through a louvred inlet and a glass type air filter. Velocity through the net area of the louvres will not exceed 1000 feet per minute and through the filters, will not exceed 300 feet per minute. Each of the fans shall be of the centrifugal type, and of Class I construction only with horizontal shaft and vertically upward discharges. The motor for each fan shall be open type squirrel cage induction motor to operate at 440 volts, three phase, 60 cycle, at a satisfactory speed with respect to fan speed and under a temperature rise not to exceed 40°C.

In any one building, fans will normally operate in two sets, or systems of two to five fans each, in parallel arrangement. The lower horizontal duct into which the fans discharge, will be run continously through the building. In case one or more fans are shut down, air shall be supplied to the system so affected by the remaining fans in that system. Therefore, no spare fans are used.

The operating characteristics of each fan shall be such that any number of fans, from two to five, may be operated in parallel on any one system without hunting, and, under any condition of multiple operation, each fan shall automatically assume its proportionate share of the total load. Fans of dissimilar make will not be located in any one building. Fans shall have the characteristic which will prevent overloading at rated speed. Rotors of fans and motors shall be statically and dynamically balanced and shall run at rated speed substantially free from vibration.

FAN DAMPERS

Each fan shall be provided with an automatic louvre type damper at the outlet, which shall substantially prevent flow when fully closed, and which shall close automatically when the fan it serves is not operating. These dampers shall also be provided with limit opening stop which will also permit limiting

discharge flow from zero to maximum opening.

AIR FLOW

Air is distributed throughout the building at a series of three locations for each row of cells, as follows:

(1) At the curbing between the withdrawal alleys and the converter floors.

(2) Across the top of the cells on the withdrawal alley side.

(3) In the motor alley and a little above the converter floor.

Air from the basement goes through a fan and into a transverse duct making a cross connection between two longitudinal ducts under one row of cells. Figure II.1-13 shows a cross section of duct arrangement, and indicates the outlets for the cells as listed above.

The fans for each row of cells operate as two separate groups. One group of cells will be discussed only but the information applies to either one.

The longitudinal ducts run the full length of the cells below the converter floor with one duct being located under each row of process blowers. All the fans in one row are tied together by these longitudinal ducts. The air to the duct toward the center of the building supplies the motor alley risers and outlets, of which there are four distributed along each cell. Air from these outlets rises to a ventilator intake located in the pipe gallery floor where it is carried up by a duct through the operating room and roof to the atmosphere. In Building K-302-3, there are ten such ventilators from the pipe gallery floor to the outside atmosphere, located down the center of the building.

The duct to the withdrawal alley side supplies air to the withdrawal alley and the top of the cell. There are four risers and outlets per cell supplying air to the withdrawal alley. Two additional risers supply air to the slotted duct on top of the cell. This slotted duct is 5/16" wide and extends the length of the cell. Figures II.1-13 and II.1-14 show the arrangement of this duct. Discharge from the slotted ducts mixes with the motor alley air and is handled as previously mentioned.

The air from the curbing outlets goes up through the pipe gallery floor to the ventilator intake which is located in the operating floor. The duct between the operating floor and roof conducts the air to the atmosphere (Figure II.1-13). There are twenty such ventilators per row of cells through the operating floor to the atmosphere in Building K-302-3.

[redacted]

AIR CONTROL

There are no dampers in the longitudinal ducts, but each fan is provided at its outlet with an automatic damper which is closed when the fan it serves is not running. By reason of this design, the static pressure in the basement plenum ducts can be varied and the total amount of air supplied, correspondingly increased or decreased by operating any number of fans from one to five. Control of a complete row of fans may, therefore, be accomplished by starting or stopping fans. The fans are controlled from the basement, each fan having a switch located on a panel board.

By means of dampers at each outlet, the flow may be proportioned to any part of the ventilating system. If a cell is inoperative due to repairs, or replacements, the dampers in the risers to the slotted duct will be closed, prohibiting the flow of air to the top of the cell. Dampers in the outlets to the motor alley and withdrawal alley will be adjusted to allow a smaller flow since the heat to be dissipated from the pumps will be decreased. One of the fans may be shut down because of the smaller quantity of air required.

The temperature of the discharged cell ventilating air indicates ambient temperature conditions within the cell. By regulating cell ventilating air or by operating the electric heaters located within the cell, the ambient cell temperature is completely controlled. When a cell is to be placed in operation, the required minimum ambient temperature is reached by means of the electric heaters and the cell is started. The heaters are on thermostatic control and discontinue automatically as soon as equipment within the cell is generating sufficient heat. From this point on, the temperature within the cell is maintained at the design requirements by regulating, through dampers and the number of fans in operation, the amount of air fed to the ducts at the top of the cell and in the motor alley. The quantity of air depends on the temperature of the available air supply, but is a maximum in the warm season.

The table below lists the following items:

(1) Maximum ambient cell design temperatures.
(2) Minimum allowable ambient cell temperatures.
(3) Temperature rise of the ventilating air during maximum ambient cell temperature conditons and maximum summer atmospheric air condition (100°F.)

Section	Maximum Ambient Cell Design Temperature	Minimum Allowable Ambient Cell Temperature	Ventilating Air Temperature Rise
-3	159°F.	105°F.	20°F.
-2	157°F.	105°F.	20°F.
-1	153°F.	105°F.	30°F.
1	153°F.	105°F.	30°F.

[redacted]

Section	Maximum Ambient Cell Design Temperature	Minimum Allowable Ambient Cell Temperature	Ventilating Air Temperature Rise
2a	157°F.	105°F.	20°F.
2b	157°F.	105°F.	20°F.
3a	140°F.	90°F.	10°F.
3b	137°F.	90°F.	10°F.
4	128°F.	80°F.	8°F.

When atmospheric temperatures are lower than 100°F., the air fed to the cell enclosure is throttled and a larger temperature rise of the ventilating air occurs. Under such conditions, the ambient cell temperature is less than the maximum but sufficient ventilation must be provided to keep the temperature above the minimum.

Resistance thermometer elements are located at the entrance of the cell ventilating ducts which exhaust from the top of the motor alley through the roof. There is one less resistance unit than the number of cells in the length of that building. For example, Building H-302-F, having ten cells, contains four resistance elements. The temperature of the cell ventilating air is indicated on the building instrument board. A selector switch connecting to each resistance unit provides for reading the temperature of the ventilating air from any cell in the building.

From the thermometer resistance elements the operator is informed as to the effects on cell ventilating conditions of changes in atmospheric temperature and quantity of air supplied. If the atmospheric temperature drops, the effect is soon noticed on the ventilating air temperatures. Since the temperature is lower, a smaller volume of air is required. The dampers at the fan and duct outlets should be regulated to allow less air to circulate. If the temperature should continue to drop, one or more fans may be shut down. Conversely, if the temperature rises, the opposite procedure is followed. The dampers are adjusted to allow a greater volume of air to circulate, and additional fans may be started. Thus, a fairly constant temperature, as required for the process, is maintained on the converter cell floor. Except for maximum summer conditions, at least one fan is held as a spare. Operation of the fans should be so regulated that wear is distributed evenly over all of the fans.

In view of the fact that all process enclosure ventilating requirements are being handled by one set of fans per row of cells, and especially that the high velocity required at the cell ceiling slots imposes a high pressure on the whole system, it is necessary to meter the flow at the withdrawal alley and motor alley outlets by a set of orifices. These orifices, one in each duct, are located in the flange where the ducts connect to the basement plenum system. The area for those orifices has been calculated to limit the flow

[redacted]

[redacted]

at the respective points to the maximum calculated quantity. As previously stated, lesser quantity may be delivered by the system according to requirements by operating dampers located in each withdrawal alley and motor alley outlet.

The ducts on top of the cells are slotted to give a high velocity of from 3500 to 6500 FPM, depending on the building, with all fans operating. The object of this high velocity and consequent scrubbing action is to increase the overall heat flow from the metal ceiling of the cell. This, together with exposed surface in action and temperature differences calculated, will produce equilibrium heat flow condition of the temperatures of the process material. Figure II.1-15 shows a typical cell with motor alley, slotted duct, and withdrawal outlets, and the vent ducts to the atmosphere. The quantities of air and required temperatures for all buildings are listed. Air quantities shown are for a maximum summer temperature of 100°F.

Following is a list of reference drawings pertaining to converter cell floor ventilation not contained in this manual because of space limitations. They show details of ductwork, ventilators, louvres, and dampers.

Kellex Dwg. No.	Title
302-1K-37AA	Basement Plan-One Cell Length Ventilation
302-1K-37BA	Stage Cell Floor Plan - One Cell Length Ventilation
302-1K-37KA	Arrangement of Ventilating Ducts in Cell Area
302-1K-37MA	Details and Connections for Branch Ducts Sheet 1 of 2
302-1K-37NA	Details and Connections for Branch Ducts Sheet 2 of 2

Operating Floor Ventilation

The fans for the operating floor are located down the center of the basement floor between the two rows of cell fans, and operate from the same filters. Figure II.1-13 shows the location of the row of operating floor fans.

The number of ventilating fans for the operating floor varies with the size of the building. With the exception of Section 4, all

[redacted]

[redacted]

ten cell buildings have five operating floor fans, all eight cell buildings contain four fans, and all six cell buildings house three operating floor fans. Each building in Section 4 has three operating floor fans.

These fans were supplied by the same vendors as for the cell ventilation. Table II.1-2 lists the schedule and characteristics of these fans. The same numbers for drawings and performance curves apply to these fans as those used for the cell fans, Figure II.1-3, to II.1-12, inclusive.

FAN SPECIFICATION

The specifications for ventilating fans for operating floors are the same as those given previously for the converter cell fans, except for the description of the duct work which is as follows:

> Each fan will discharge vertically upward into a duct not over 8 feet long and 2'-6" x 5'-0" cross section. This riser will connect to the center of a horizontal duct also 2'-6" x 5'-0" cross section and running continuously through the building. At a point about 20 feet on each side of each fan, the horizontal duct will discharge into a 2' x 3' duct running horizontally approximately 6 feet to an elbow, and from the latter rising vertically a distance of approximately 50 feet, there branching into two horizontally opposed ducts, each 30 feet long and having initial cross section of approximately 6 sq. ft. These horizontal ducts will be tapered and each side of the duct will be provided with thirteen dampered outlets or grilles for proportioning flow, each having an area or approximately 1 sq. ft.

There has been one major change in the ductwork, since the specifications were made up. The horizontal ducts in the operating floor have been redesigned and cut off close to the end of the riser. This affects all buildings except a few in the 2B section. The air will blow directly into the operating room instead of through the horizontal ducts and outlets. These ducts will remain, however, in the office areas as they will carry ventilating air to the offices. Figure II.1-13 shows the duct arrangement to the operating floor. The transverse duct on the operating floor is shown as a dashed line as it would appear when ventilating the offices. For office ventilation, there are extensions from the ends of the transverse ducts to the two offices on each floor. For the rest of the operating room ventilation, the ducts end as shown by the solid line. The air is discharged from the operating room to the outside atmosphere through a row of ventilators located in the roof.

[redacted]

[redacted]

TABLE II.1-2

SCHEDULE FOR OPERATING FLOOR VENTILATING FANS

GROUP	310 311 -2,-3	309, 301 1,-1	302, 303 2A, 2B	304 3A	305 3B	306 4
NAME OF MAKER	BUFFALO FORGE	B.F. STURTEVANT	BUFFALO FORGE	BUFFALO FORGE	AMERICAN BLOWER	BUFFALO FORGE
NO. OF FANS	16	28	71	25	60 *	18
TYPE FAN	#6 1/2 "LL"	DESIGN 7 #100 SILENTVANE	#6 1/2 "LL"	#6 1/2 "LL"	#6	#7 "LL"
CFM	23,000	28,000	23,000	21,000	21,000	30,000
RPM	695	712	671	635	1050	676
STATIC PRESSURE @ 95°F. & 70% RH	1.37"	2.0"	1.17"	1.14"	1.5"	1.65"
BHP @ 95°F. & 70% RH	9.0	14.7	8.2	6.85	11.5	13.7
LIM. HP @ 95°F. & 70% RH	9.3	15.0	8.34	7.1	14.0	14.06
OUTLET VELOCITY FT./MIN.	2475	3000	2475	2260	2945	2640
STATIC EFF.	55%	59.2%	52%	55%		56.7%
TIP SPEED FT./MIN.	7300		7120	6670		7890
MAX. SAFE SPEED RPM	825		825	825		746
MOTOR HP	10	15	10	7.5	15	15
MOTOR RPM	1740	1745	1740	1749	1745	1745
MOTOR FRAME	324		324	324	326	326
BELT HP	14.7	19.5	14.4	14.7	19.5	18.5
WEIGHT UNIT #	1970	1400	1975	1970	1070	2185
MOTOR MAKE	WESTINGHOUSE	G. E. CO.	WESTINGHOUSE	WESTINGHOUSE	WESTINGHOUSE	WESTINGHOUSE

* 5 Fans Missing

[redacted]

AIR CONTROL

The air control is very flexible and should be able to meet all needs. Any combination of the operating floor fans can be run at one time. Since the large horizontal duct in the basement is so large, and the pressure drops small, the pressure at any of the risers should be fairly equal, regardless of what fans are running. Each fan carries an automatic damper in the discharge of the fan. The object of these dampers is to prevent return flow or by-passing through any fan which is not running, and to that end, these dampers will automatically close when any fan is removed from the line. In addition to this, these automatic dampers are provided with limit stops so that the flow can be limited with all fans running. It is anticipated that these limit stops will be operated on a seasonal basis.

In each riser, at a point convenient for manipulation from the operating floor, there is a damper. These dampers control the amount of air to the operating floor. It is important that an equal flow be taken at each riser to prevent objectionable cross currents.

The large ventilators running in a line approximately across the center of each operating floor carry a series of louvre dampers which open directly into the operating room and are controlled from the operating floor. These dampers will be opened wide for operation under maximum summer conditions and a lesser amount in accordance with conditions as described later on.

With inlet air at 95°F. and 70% relative humidity, it is estimated that the air will discharge at a temperature at 100°F. This 5 degree rise in temperature is based on absorbing heat transmitted to the operating floor from solar roof load, lights, and warm space below the floor.

Following, is a list of reference drawings not included in the manual showing details of ductwork, louvres, and ventilators pertaining to operating floor ventilation.

Kellex Dwg. No.	Title
302-1K-37DA	Operating Floor Plan - One Cell Length Ventilation
302-1K-37CA	Pipe Gallery Floor Plan - One Cell Detail Ventilation
302-1K-37EA	Roof Plan - One Cell Length Ventilation

[redacted]

302-1K-37-HA	Arrangement of Roof Ventilation Located in Cell and Driveway Areas
302-1K-37LA	Arrangement of Ventilating Ducts in Driveway Area
302-1K-37PA	Ventilation of Offices on Operation Floor

Recycling

The operation of the cell and operating floor ventilating systems together will be necessary when the outside air becomes such that the operating floor becomes too cool. A system of recycling the ventilating air has been incorporated into the design so that part or all the heat generated on the cell floor may be retained. This is accomplished by the manual operation of various louvres, dampers, and the number of fans running.

DAMPER OPERATION

These dampers have four general locations throughout each building, as listed below:

(a) In the ventilators going from the operating room to the atmosphere. See dampers marked "A", Figure II.1-13.

(b) With a series of grilles in the operating floor which will connect the operating room and withdrawal alley. See grilles marked "B", Figure II.1-13.

(c) In the ventilator ducts leading from the motor alley way to the atmosphere. Louvres are located in these ducts above and below the operating floor. See louvres marked "C", Figures II.1-13 and II.1-14.

(d) In the withdrawal alley curbing. These will connect the basement with the withdrawal alley. See dampers marked "D", Figure II.1-14.

The amount of air circulated will be governed according to requirements by a reduction of fans operating and damper operation. The recycling is then accomplished by:

(1) Fully or partly closing the louvres "A" to the atmosphere.

(2) Opening the dampers "B" in the series of grilles located on the operating floor.

[redacted]

(3) Opening to such an extent as may be required, the series of louvres "C" in the large discharge ducts from the motor alleys.

(4) Opening the dampers "D" in the curbing to withdrawal aller.

Operations (2), (3), and (4) must be performed before the louvres "A" are closed to prevent an undue rise in pressure.

AIR FLOW

The above four operations will make possible another source of air for the basement which comes through the curbing grille. Air will come into the basement at any point possible since it will be at a pressure about 0.4" w.g. below atmospheric pressure. There is no provision made for regulating the flow of air through the filters at the end of the building. The intake to the basement will be proportional to the pressure drops in the sources of air. The building air being warmer than atmospheric air, will be discharged to the operating floor and alleways. The proper operation of the dampers "D" will regulate the amount of warm air to the operating room. By suitable proportioning of the flow through these by-passes, recycling may be accomplished to obtain conditions desired at the process equipment without creating undesirable conditions in the operating room. In the cooler winter weather, a substantial proportion of the recycled air will be passed through the operating floor. The system is considered adequate for winter conditions when most, if not all, of the heated air is retained in the buildings by recycling.

Transformer Vault Ventilation

The transformer vault ventilation system has the function of keeping the vault ambient air temperature below set limits. Air flow is induced through each vault by three Buffalo Forge axial flow fans, varying in size from 20" to 36", depending upon the quantity of air required. Fans in each vault are all of the same size. Table II.1-3 lists the vault numbers, fan sizes, and fan characteristics.

Figure II.1 [illegible] is a Buffalo Forge drawing showing the fans used with a table of dimensions for the different sizes. Figure II.1-17 to II.1-[illegible]1 inclusive are performance curves for the various sizes.

FAN SPECIFICATIO

The CFM required per vault, as specified in Table II.1-3, is estimated to exceed, by at least 10%, the actual CFM needed for dissipating by air circulation, the heat generated per vault in the transformer windings when operating under maximum summer conditions. Under these conditions, incoming

[redacted]

[redacted]

TABLE II. 1-3

SCHEDULE FOR

TRANSFORMER VAULT VENTILATING FANS

Vault Numbers	No. Fans	Total CFM Required	CFM Per Fan	Name of Maker	Static Press. @ 0.0682 Density	Size Fan	RPM	BHP @ Density	Limit HP @ 70°F.	HP Motor
1	3	45,200	22,600	Buffalo Forge	1.73"	32"	1645	11.55	12.9	20
2	3	57,800	28,900	"	2.14"	36"	1527	17.1	18.6	25
3	3	34,800	17,400	"	1.58"	28"	1855	8.4	9.5	15
4	3	50,200	25,100	"	1.95"	32"	1800	15.0	16.9	20
5	3	55,200	27,600	"	2.14"	36"	1500	15.9	17.5	20
6	3	47,500	23,800	"	1.91"	32"	1730	13.4	15.1	20
7	3	54,000	27,000	"	2.07"	36"	1470	15.0	16.5	20
8	3	60,400	30,200	"	2.37"	36"	1605	19.7	21.6	25
9	3	50,250	25,000	"	1.82"	32"	1780	14.35	14.9	20
10	3	48,100	24,000	"	1.68"	32"	1710	12.5	13.2	20

[redacted]

[redacted]

Vault Numbers	No. Fans	Total CFM Required	CFM Per Fan	Name of Maker	Static Press. @ 0.0682 Density	Size Fan	RPM	BHP @ Density	Limit HP @ 70°F.	HP Motor
11	3	48,100	24,000	Buffalo Forge	1.68"	32"	1710	12.5	13.2	20
12	3	48,100	24,000	"	1.68"	32"	1710	12.5	13.2	20
13	3	39,200	20,000	"	1.16"	32"	1425	7.25	7.65	10
14	3	20,000	10,000	"	0.75"	24"	1630	2.62	2.78	5
15	3	24,400	12,250	"	1.68"	24"	2160	6.16	6.43	10
16	3	25,950	13,000	"	1.82"	24"	2250	6.95	7.25	10
17	3	21,600	11,000	"	1.3"	24"	1900	4.22	4.4	7.5
18	3	19,700	10,000	"	1.75"	24"	1940	4.49	4.97	7.5
19	3	19,700	10,000	"	1.75"	24"	1940	4.49	4.97	7.5
20	3	19,700	10,000	"	1.75"	24"	1940	4.49	4.97	7.5
21	3	19,700	10,000	"	1.75"	24"	1940	4.49	4.97	7.5
22	3	19,700	10,000	"	1.75"	24"	1940	4.49	4.97	7.5

[redacted]

[redacted]

Vault Numbers	No. Fans.	Total CFM Required	CFM Per Fan	Name of Maker	Static Press. @ 0.0682 Density	Size Fan	RPM	BHP @ Density	Limit HP @ 70°F.	HP Motor
23	3	17,200	8,600	Buffalo Forge	1.5"	20"	2525	3.95	4.37	7.5
24	3	15,400	7,700	"	1.5"	20"	2350	3.25	3.57	5
25	3	15,400	7,700	"	1.5"	20"	2350	3.25	3.57	5
26	3	15.400	7,700	"	1.5"	20"	2350	3.25	3.57	5
3 Extension	3	8,100	5,000	B. F. Sturtevant	0.94"	27"	695			1
4 Extension	3	9,280	5,000	"	0.94"	27"	695			1
5 Extension	3	8,100	5,000	"	0.94"	27"	695			1
6 Extension	3	9,280	5,000	"	0.94"	27"	695			1

Buffalo Forge Fans have G. E. Co. motors.

Sturtevant Fans have B. F. Sturtevant motors.

[redacted]

air to vaults will be at 95°F. and 70% relative humidity, and air exhausting from vaults to fans at 115°F., for a maximum temperature rise of 20°F. The total capacity in any vault is to be carried by any two fans, the third being held in reserve as a spare, or to alleviate extreme summer conditions.

All fans are of the true axial flow type arranged with vertical shaft with downward flow and driven by 440 volt, 3 phase, 60 cycle squirrel cage induction motor, mounted outside fan casing and operating the fan through a V-belt drive. Fans are equipped with intake guide vanes and a transformation piece or intake cone for suction connection and diffuser at the outlet. Motors shall deliver rated capacity under a temperature rise above ambient, not to exceed 40°C.

All fans have characteristic operating curves which will permit parallel operation without hunting, and all fans connected to any one system, automatically assume their proportionate shares of the total load. Operating curves have the characteristic which will prevent overloading at rated speed.

Each fan is provided with a louvre type damper, of rectangular section, integrally mounted in discharge outlet of fan, which will automatically close when fan it controls is not running. This damper shall substantially prevent flow when fully closed.

These fans are mounted so the suction cone will connect directly to an overhead duct and the discharge diffuser will connect directly to a concrete duct located beneath the floor. The fan suction and discharge cones make direct connection at these two points without any additional filler pieces.

AIR FLOW

Outside air passes through the filter system and into a supply duct running through the center and length of the vault beneath the floor, and is distributed through a series of holes in the floor throughout the vault area. The heated air is exhausted from the vault ceiling into a duct having numerous grilles with simple slide dampers for uniform withdrawal. This suction duct connects to the fan suction plenum chamber at the opposite end of the building from the intake filters. Air passes through the suction duct and plenum to the fans and then discharged to the atmosphere. The duct work and fans for transformer vault ventilation are shown in Figure II.1-22.

AIR CONTROL

The three fans in each vault are controlled automatically by thermostats located in the vault and suction duct. The first of the three ventilating fans starts operating under the control of any one of the three thermostats equally spaced through the center of the vault and in the ceiling. Three thermostats in parallel connection are used as a precaution

against unequal distribution of heat in case certain transformers are not in use. The second and third fans will operate under control of thermostats in the air duct at the ceiling near the fans. Under maximum summer temperatures, and full load conditions, the first fan thermostats will be set at 95°F. to 100°F. and the third at 115°F. to 120°F., with the other fan used as a spare. The settings can be moved to meet any conditions that might arise.

It should be noted that the thermostats in ducts for #2 and #3 fans are of no use unless there is air flow in the duct. To remedy this situation an electrical control box has been included. In the event #1 fan should refuse to start under thermostatic control, the second fan is automatically connected to the room thermostats. In similiar automatic fashion, the third fan receives control from these room thermostats in case the second fan fails to start. Any of the three fans can be rated #2 and #3 in order of operation. The purpose of this device is to distribute wear on the fans, but primarily to avoid difficulties in case the fan connect to the room thermostats should fail to respond.

Vault Extensions

The transformer vault extensions in alleys 3, 4, 5 and 6 have ventilation systems which operate independent of the main vault systems. Air passes through the vault extension filters as previously described and to the suction of three 27" B.F. Sturtevant Roofvane fans located on the roof of each extension. Figure II.1-23 is a Sturtevant drawing of this fan. Figure II.1-24 is a performance curve.

Each combination fan ventilator shall have capacity to exhaust 5000 CFM of air under initial intake maximum summer conditions of 95°F. and 70% relative humidity and raised to 115°F. maximum at the point of exhaust. Air will be supplied to the rooms to be ventilated through a louvred inlet at a velocity not to exceed 750 CFM through the net opening and then through a filter of the replaceable glass fiber type at a velocity of not over 325 ft. per minute. Duct velocities will be in the range of 1300 to 1350 ft. per minute. The total pressure against which the fans must operate, including pressure drop through filters, automatic louvred dampers, ducts, etc., will be approximately 1" water column.

The motor is mounted above the fan and accessible for servicing from the roof of the building through a door in the ventilator.

The fan-ventilators shall not leak water into the build-

ing, whether the fan is in operation or not, under any condition of atmospheric wind and water.

DAMPERS

A rectangular louvre type automatic damper, with adjustable balancing counterweight, is provided with each fan. This damper shall substantially prevent flow when fully closed and shall automatically close when the fan it serves is shut down.

AIR FLOW

Air passes through the filter chamber and is distributed through a transverse 36" x 30" duct across the ceiling of the extension. At a point about halfway across the extension, the transverse duct narrows to 24" x 30". From this duct five vertical downcomers extend down and discharge horizontally at the floor. The air rises through the transformers and is exhausted by the roof fans. Figure II.1-22 includes a drawing of the vault extension ductwork.

FAN CONTROL

The vault extension fans are controlled by three thermostats in a manner similiar to that employed for the regular vault fans. As in the case of the transformer vault fans, two of the fans will carry the ventilating load, the third used as a spare or for extreme conditions.

Fan Maintenance

The following information on maintenance and operation of the ventilating fans consists of excerpts from the Buffalo Forge Maintenance Bulletin. However, it applies to all ventilating fans used, regardless of the vendor.

CLEANING AND CHECKING

Fan balance is directly affected by dirt collecting on the rotor. As soon as a little has stuck to a fan blade, more dust, grease, and dirt will gather there. This coating may go as far as to change the blade curvature so as to affect fan performance. Pieces of dirt lodged on the fan blades can unbalance the entire rotor. Perodic cleaning by means of a hose, scraper, compressed air or a wire brush will prevent an unbalanced condition which in turn could distort and later completely break down the impeller. Bent shafts and ruined bearings are other troubles which may be headed off in this manner. The frequency of inspections and cleanings will be determined by the amount of dirt carried by the air stream.

REPAIR PARTS

If a fan wheel is allowed to wear out completely, it may collapse due to weakness of the blades or flanges. This may injure the fan housing, shaft, bearings or even the motor. For these reasons care should be taken to inspect the rotor frequently after cleaning, and before wear has become serious. Because of details of constructions, wheels should be returned to the factory

[redacted]

for reblading or repairing of any kind.

LUBRICATION

Some of the ventilating fans in the process buildings run on sleeve bearings, and some on ball bearings. Lubrication for both will be discussed.

For the sleeve bearings, oil conforming to SAE specification No. 70 should be used. Too light an oil may cause leakage along the shaft, while if too heavy an oil is used, the bearing surface will not be properly lubricated.

The sleeve bearing reservoirs should not be overfilled, since leakage may result. The oil level should be maintained 1/8" below the top of the oil cup when the fan is standing still. Fluctuations in oil level when the fan is running will prevent true readings. Oil should be added only when the fan is not running.

It is desirable to inspect and clean bearings and bearing housings periodically. Since all lubricants have a tendency to deteriorate sooner or later, it will be necessary to change the oil. This should be done before oxidation makes cleaning too difficult. The bearings should be drained and flushed with kerosene before adding new lubricant.

Where ball bearings are used, a good grade of soda soap grease, free from chemically active material should be used. The bearings on a fan operating 24 hours a day at 1500 RPM will require lubrication once every three months.

The operator should be careful not to add too much grease. At no time should the housing be over half full.

COUPLINGS

Maintenance and repair work on the shaft couplings is negligible. Rubber bushings around the bolts that fasten the two halves together will wear out and should be replaced. The coupling clearance should be checked from time to time to see if the fan or motor shafts have been bent or otherwise thrown out of line.

V-BELT DRIVE

The tension on the V-belt drive will decrease as the belt stretches. The tension should be readjusted by the tension adjuster as required from time to time. New belts should be installed by slacking the tension, never by prying or forcing the belt into position.

The sheave alignment should be occasionally checked to prevent undue belt wearing. The drives should be protected from oil, dust and any foreign objects which might strike the belts or become lodged in the sheave grooves. Belt dressing should not be applied, since V-belts are designed for frictional contact between the sheaves and the sides of the belts. Dressing would

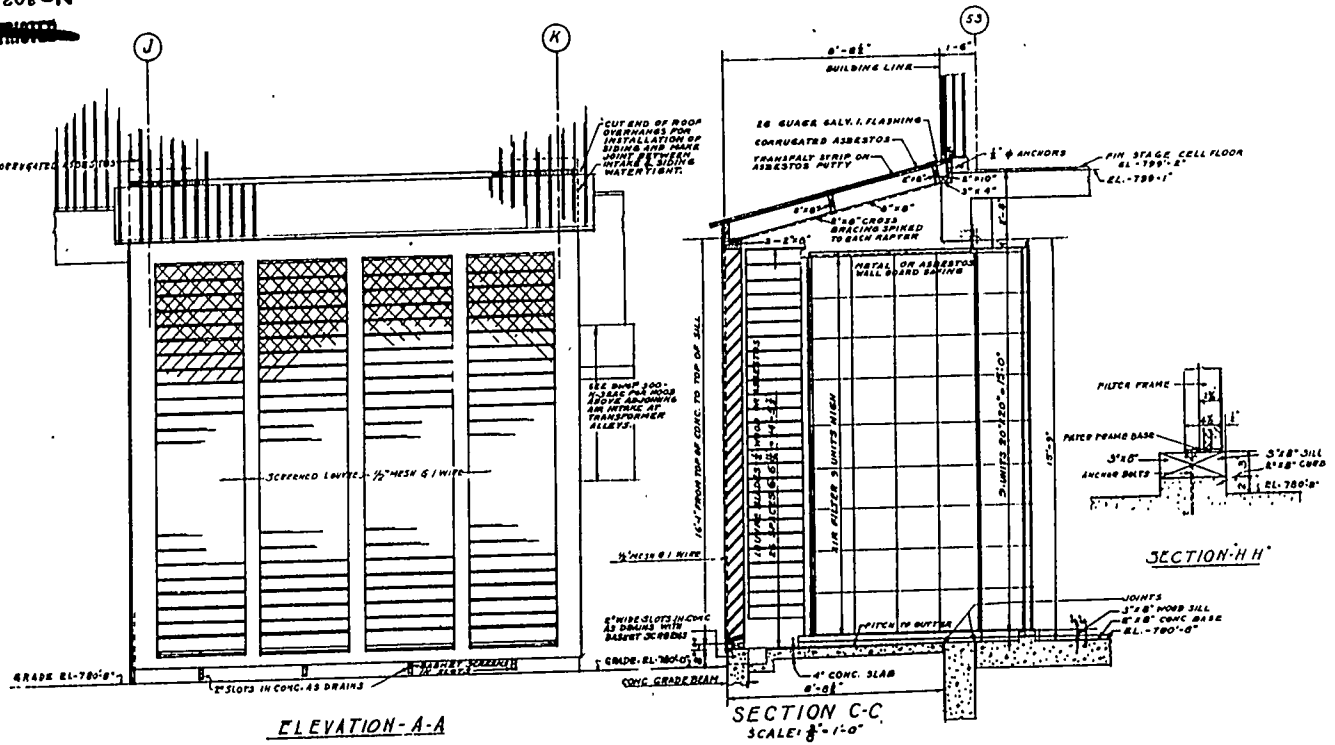
reduce this friction and possibly injure the belts.

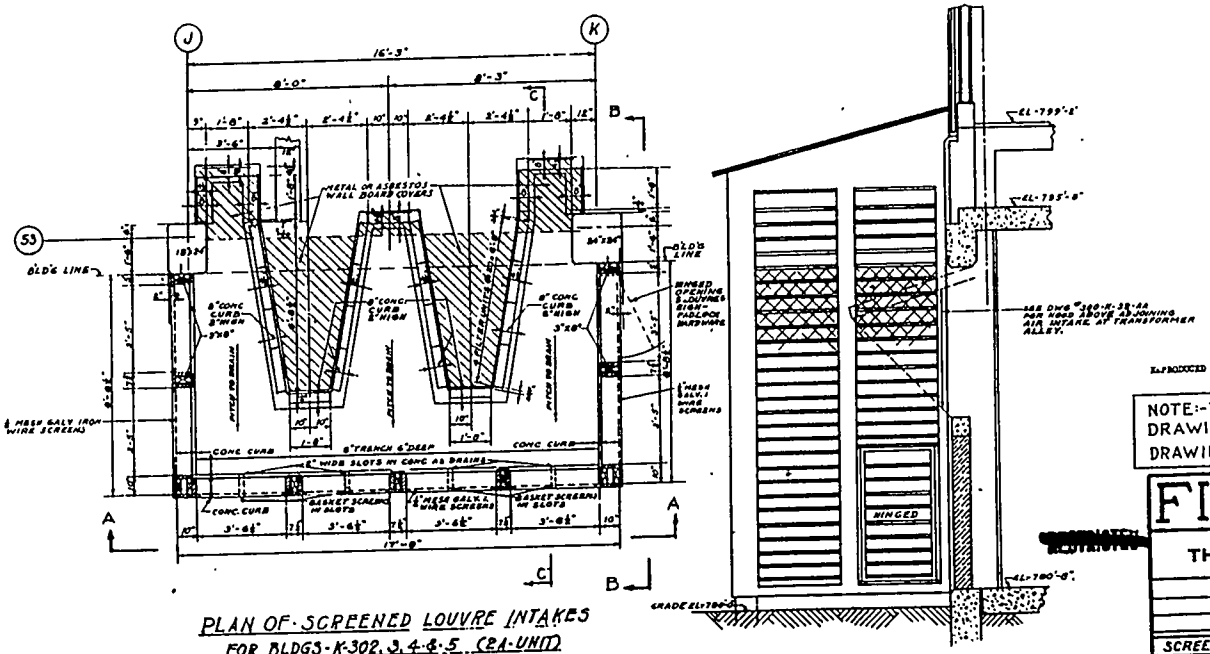
MOTORS

The maintenance of the electric motors consists chiefly of lubrication, replacement of worn bearings, and cleaning the interior and exterior of the motor from dirt, oil and grease. Motors should be occasionally disassembled for a general cleaning.

NO302-2-K30-1A

[redacted]





REPRODUCED IN PART FROM DRAWING NUMBER 302-2K-30-1A

NOTE:-THIS DRAWING SUPERSEDES DRAWING "300-K-37-AA.
DRAWING "300-K-37-AA CANCELLED.

FIGURE II.1-1

THE KELLEX CORPORATION

SCREENED LOUVRE INTAKES FOR BLDGS K-302-2,3,4 & 5 (2A-UNIT)

DRAWN C.W.TITCH DATE 5-1-44
DESIGNED
APPROVED 5-2-44

No. 302-2K-30-1A

[redacted]

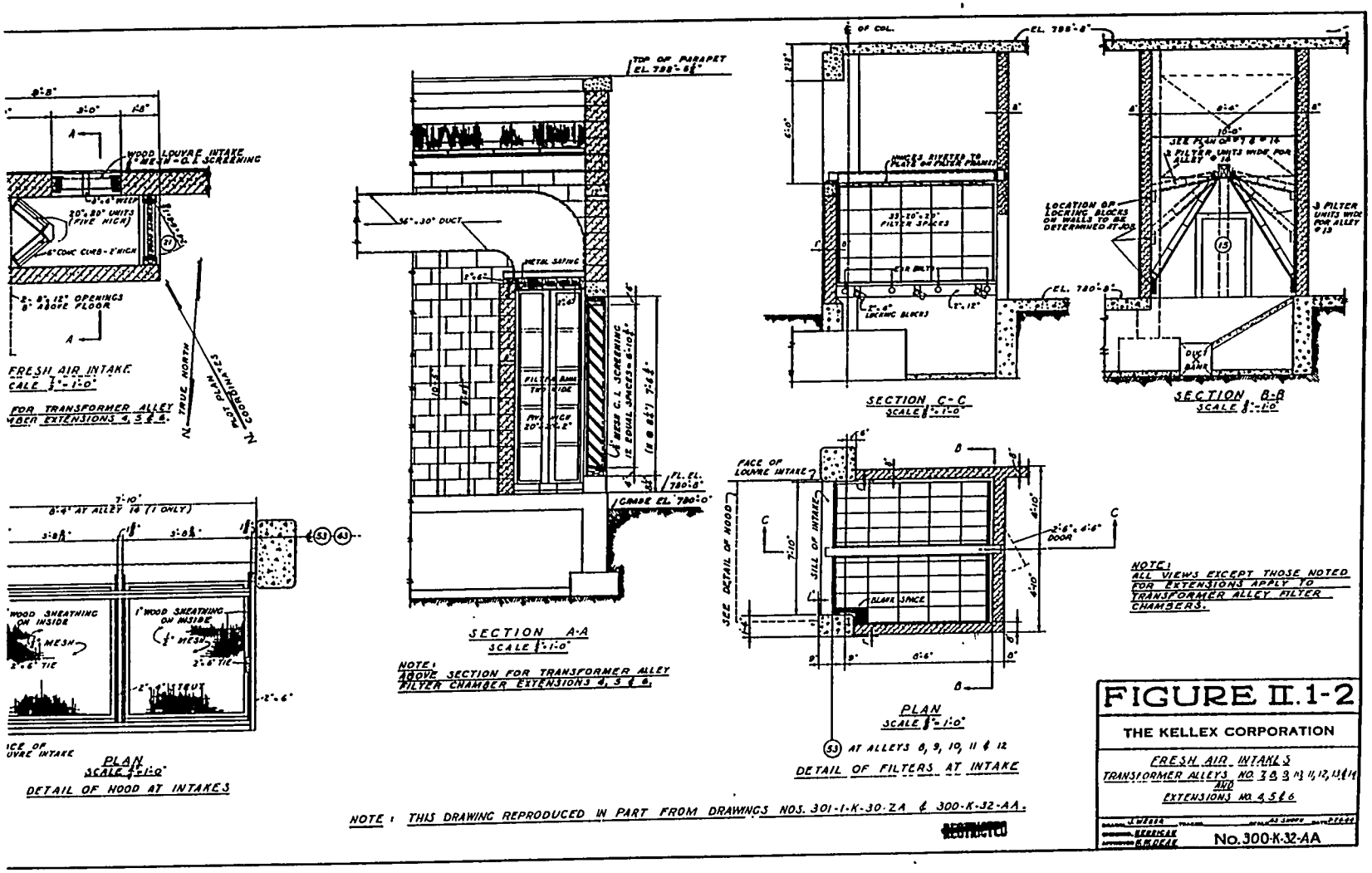
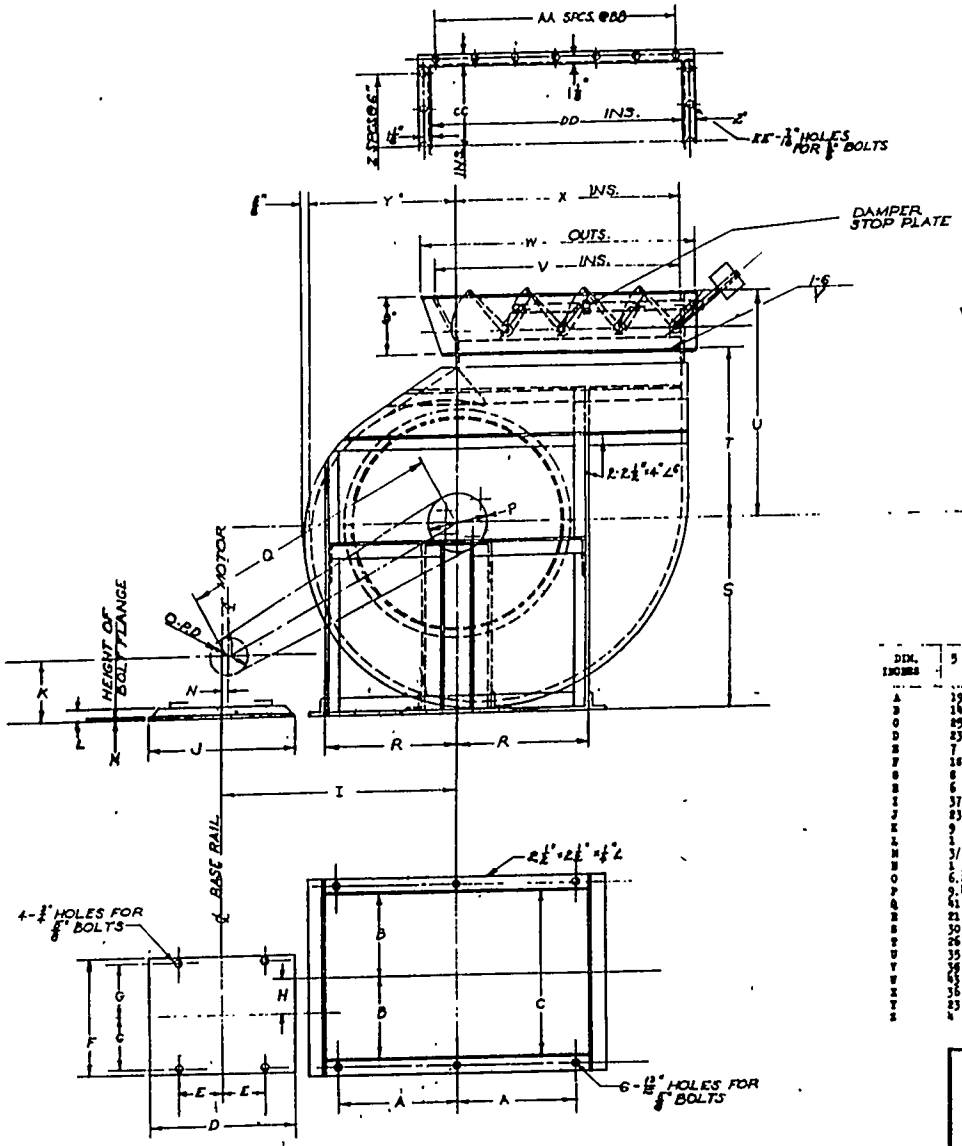
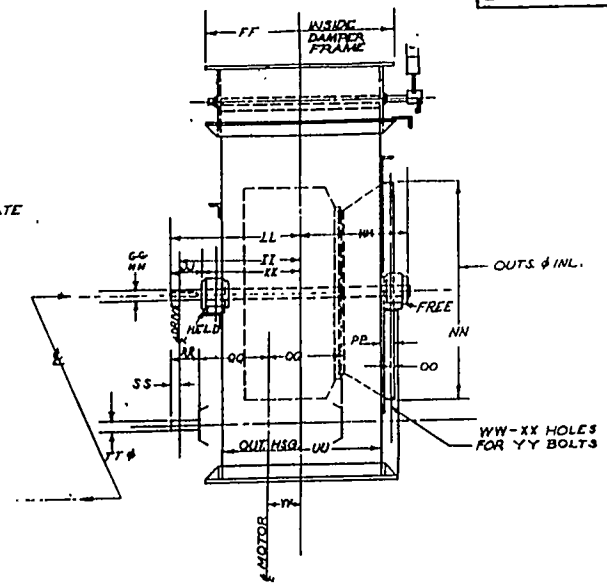

FRESH AIR INTAKE
SCALE 1/8"=1'-0"
FOR TRANSFORMER ALLEY
EXTENSIONS 4, 5 & 6.
WOOD LOUVRE INTAKE
MESH - C.L. SCREENING
20"x20" UNITS (FIVE HIGH)
6" CONC CURB - 2" HIGH
2-8"x12" OPENINGS 8" ABOVE FLOOR
TRUE NORTH
PLOT PLAN COORDINATES
PLAN
SCALE 1/4"=1'-0"
DETAIL OF HOOD AT INTAKES
WOOD SHEATHING ON INSIDE
MESH
2"x6" TIE
STRUT
SECTION A-A
SCALE 1/4"=1'-0"
TOP OF PARAPET EL. 798'-6 1/2"
36"x30" DUCT
METAL SAFING
FILTER BANK TWO WIDE
FIVE HIGH
GRADE EL. 780'-0"
FL. EL. 780'-8"
NOTE:
ABOVE SECTION FOR TRANSFORMER ALLEY FILTER CHAMBER EXTENSIONS 4, 5 & 6.
SECTION C-C
SCALE 1/8"=1'-0"
EL. 798'-8"
EL. 780'-8"
HINGES RIVETED TO PLATE ON FILTER FRAMES
33-20"x20" FILTER SPACES
EAR BOLTS
LOCKING BLOCKS
SECTION B-B
SCALE 1/8"=1'-0"
LOCATION OF LOCKING BLOCKS ON WALLS TO BE DETERMINED AT JOB
3 FILTER UNITS WIDE FOR ALLEY #13
DUCT BANK
PLAN
SCALE 1/8"=1'-0"
FACE OF LOUVRE INTAKE
SILL OF INTAKE
SEE DETAIL OF HOOD
BLANK SPACE
DOOR
AT ALLEYS 8, 9, 10, 11 & 12
DETAIL OF FILTERS AT INTAKE
NOTE:
ALL VIEWS EXCEPT THOSE NOTED FOR EXTENSIONS APPLY TO TRANSFORMER ALLEY FILTER CHAMBERS.
NOTE: THIS DRAWING REPRODUCED IN PART FROM DRAWINGS NOS. 301-1-K-30-ZA & 300-K-32-AA.
RESTRICTED
FIGURE II.1-2
THE KELLEX CORPORATION
FRESH AIR INTAKES
TRANSFORMER ALLEYS NO. 7, 8, 9, 10, 11, 12, 13 & 14
AND
EXTENSIONS NO. 4, 5 & 6
No. 300-K-32-AA

FIGURE II.1-3





BUFFALO FORGE VENTILATING FANS 5 1/2 "LL", 6 "LL", 6 1/2 "LL" 7 "LL"

DIM. INCHES	5 1/2 "LL"	6 "LL"	6 1/2 "LL"	7 "LL"	DIM. INCHES	5 1/2 "LL"	6 "LL"	6 1/2 "LL"	7 "LL"
A	19	20 1/2	22	23 1/2	AA	6	7	6	7
B	16 5/16	19 5/8	17 1/16	18 3/4	BB	6 1/4	6	6	6
C	25 7/8	28 1/2	31 3/8	34 3/4	CC	25 3/4	28 3/8	16 3/4	
D	23	27 1/8	22 3/4	22 3/4	DD	39 1/8	43 1/4	44	48
E	7	8 5/8	8	8	EE	24	26	26	28
F	18 1/4	18 1/8	19 1/4	20 3/4	FF	25 3/4	28 3/8	31 1/4	34 5/8
G	8 1/2	6 3/8	8 1/2	9 1/4	GG	1.4375	1.6875	1.9375	1.9375
H	6	5 5/8	13 1/2	15 3/4	HH	1.4370	1.6870	1.9370	1.9370
I	37 3/8	27 1/8	47	49 1/4	II	20 3/4	22 3/4	27 3/4	
J	23	27 1/8	22 3/4	22 3/4	JJ	5 9/16	6 7/8	7	7
K	9 13/16	11	10 1/2	10 1/2	KK	16 1/4	18 1/8	22 15/16	24 5/8
L	1 13/16	2	2 1/2	2 1/2	LL	21 15/16	24 3/4	29 15/16	31 5/8
M	3/16	1/4	3/16	3/16	MM	16 5/8	18 1/4	23 1/8	24 13/16
N	1 3/4	2	1 1/2	1 3/4	NN	33 3/4	37 1/4	41 1/16	45 1/2
O	6.2	9.4	7.4	12	OO	3/8	3/8	3/8	3/8
P	9.4	15.4	18.4	15	PP	2	2	2 1/4	2 1/4
Q	41	45.2	52.1	56	QQ	11 1/8	11 3/8	10 3/8	15 3/4
R	21	23	25	27 1/2	RR	5	5 3/4	5	5 1/16
S	30	33	36	40	SS	1 3/8	1 3/4	1 1/8	2 7/8
T	26 3/8	28 7/8	31 3/4	34 7/8	TT	1.625	1.875	1.625	1.625
U	35 3/8	37 7/8	43 1/8	47 3/8	UU	25 3/4	28 3/8	31 1/4	34 5/8
V	38 1/8	43 1/4	43 1/8	46	VV	6	7 3/8	13 1/2	15 3/4
W	43 1/8	47 3/4	44	48 5/8	WW	12	16	16	16
X	36 1/8	39 7/8	44	48	XX	11/32	11/32	13/32	13/32
Y	23 13/16	26 1/4	29	32 1/32	YY	5/16	5/16	3/8	5/16
Z	4	4	5	5					

[redacted]

This document contains [redacted] National defense of the United States within the meaning of [redacted] 32, as amended. Its transmission or the [redacted] in any manner to an unauthorized person is prohibited by law.

NO.	DESCRIPTION	DATE	BY	CHECKED

REVISIONS

THE KELLEX CORPORATION

BUFFALO FORGE FANS, 5 1/2 "LL", 6 "LL", 6 1/2 "LL", 7 "LL" UPBLAST DISCHARGE — ARR. #3.

FOR

DRAWN TRACED GAVIN/NALVO/H SCALE 1"=1'-0" DATE 11/1/44

CHECKED

APPROVED

No. 5W-3152

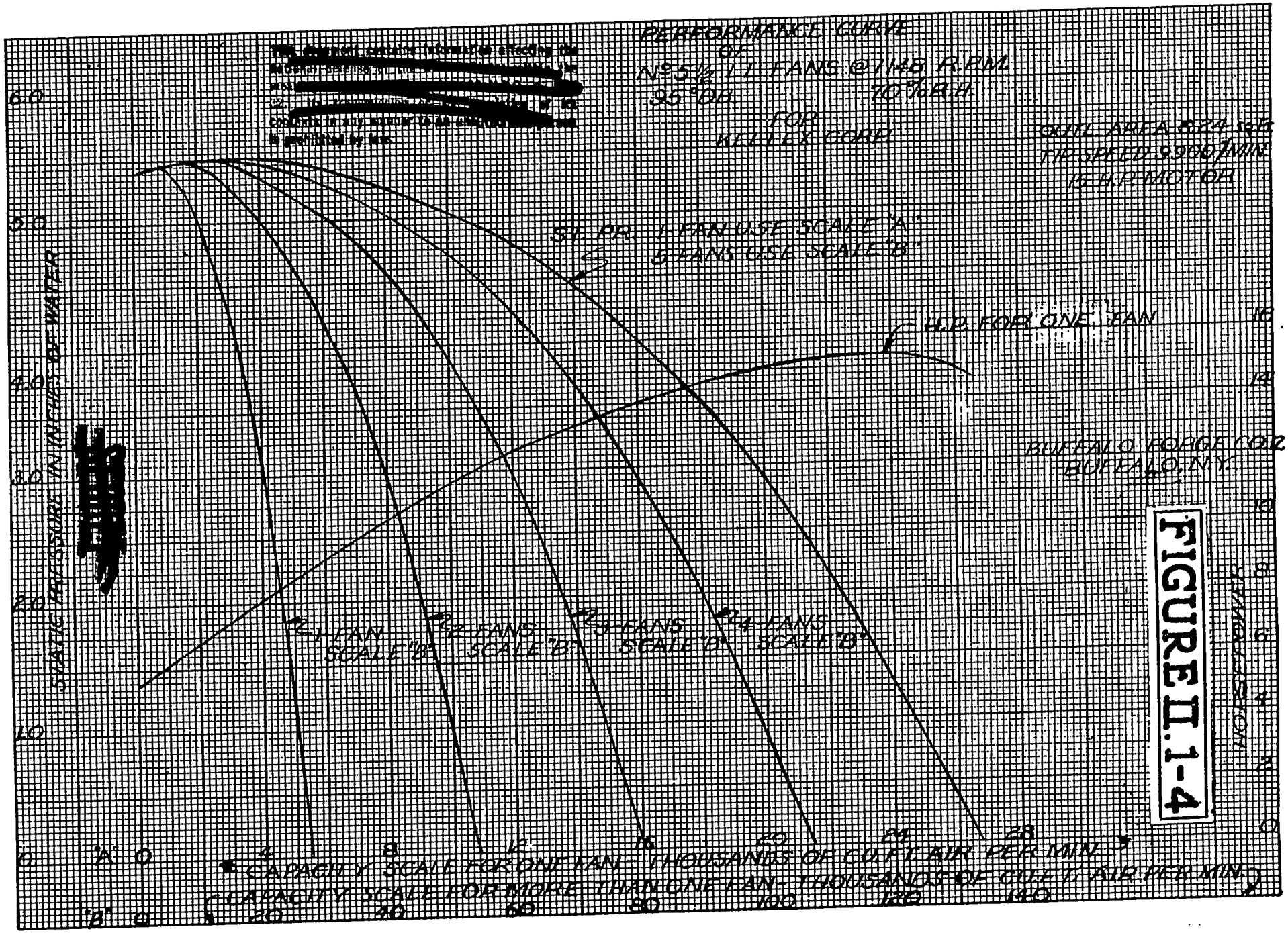

PERFORMANCE CURVE
OF
Nº 5½ I.I. FANS @ 1148 R.P.M.
95° DB. 70% R.H.
FOR
KELLEX CORP.
OUTL. AREA 8.24 sq.ft.
TIP SPEED 9900/MIN.
15 H.P. MOTOR
ST. PR. 1-FAN USE SCALE "A"
5-FANS USE SCALE "B"
H.P. FOR ONE FAN
BUFFALO FORGE CO.
BUFFALO, N.Y.
1-FAN SCALE "B"
2-FANS SCALE "B"
3-FANS SCALE "B"
4-FANS SCALE "B"
STATIC PRESSURE IN INCHES OF WATER
HORSEPOWER
CAPACITY SCALE FOR ONE FAN - THOUSANDS OF CU.FT. AIR PER MIN.
CAPACITY SCALE FOR MORE THAN ONE FAN - THOUSANDS OF CU.FT. AIR PER MIN.
"A" 0 4 8 12 16 20 24 28
"B" 0 20 40 60 80 100 120 140
0 1.0 2.0 3.0 4.0 5.0 6.0
0 2 4 6 8 10 12 14 16

FIGURE II.1-4

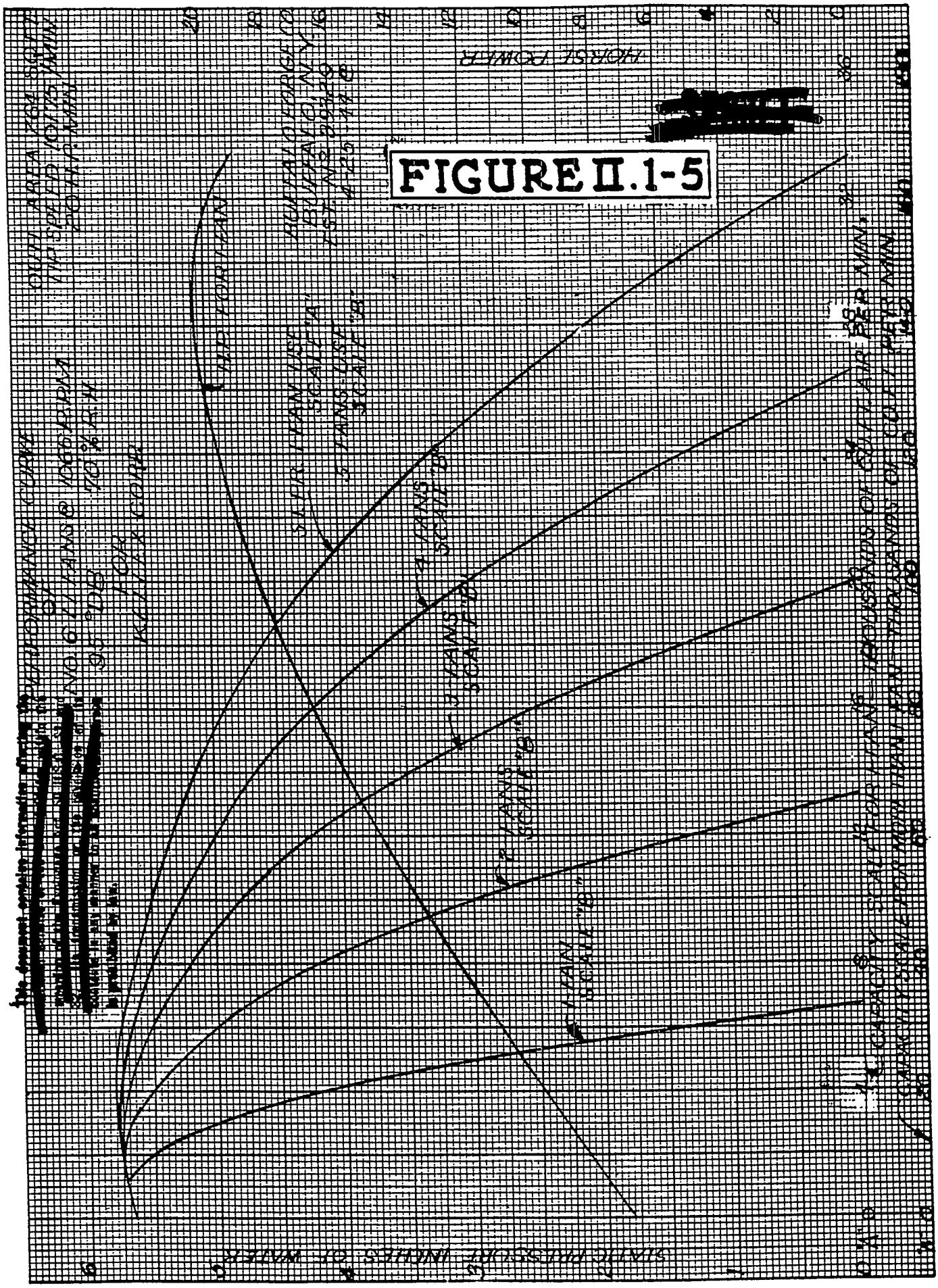
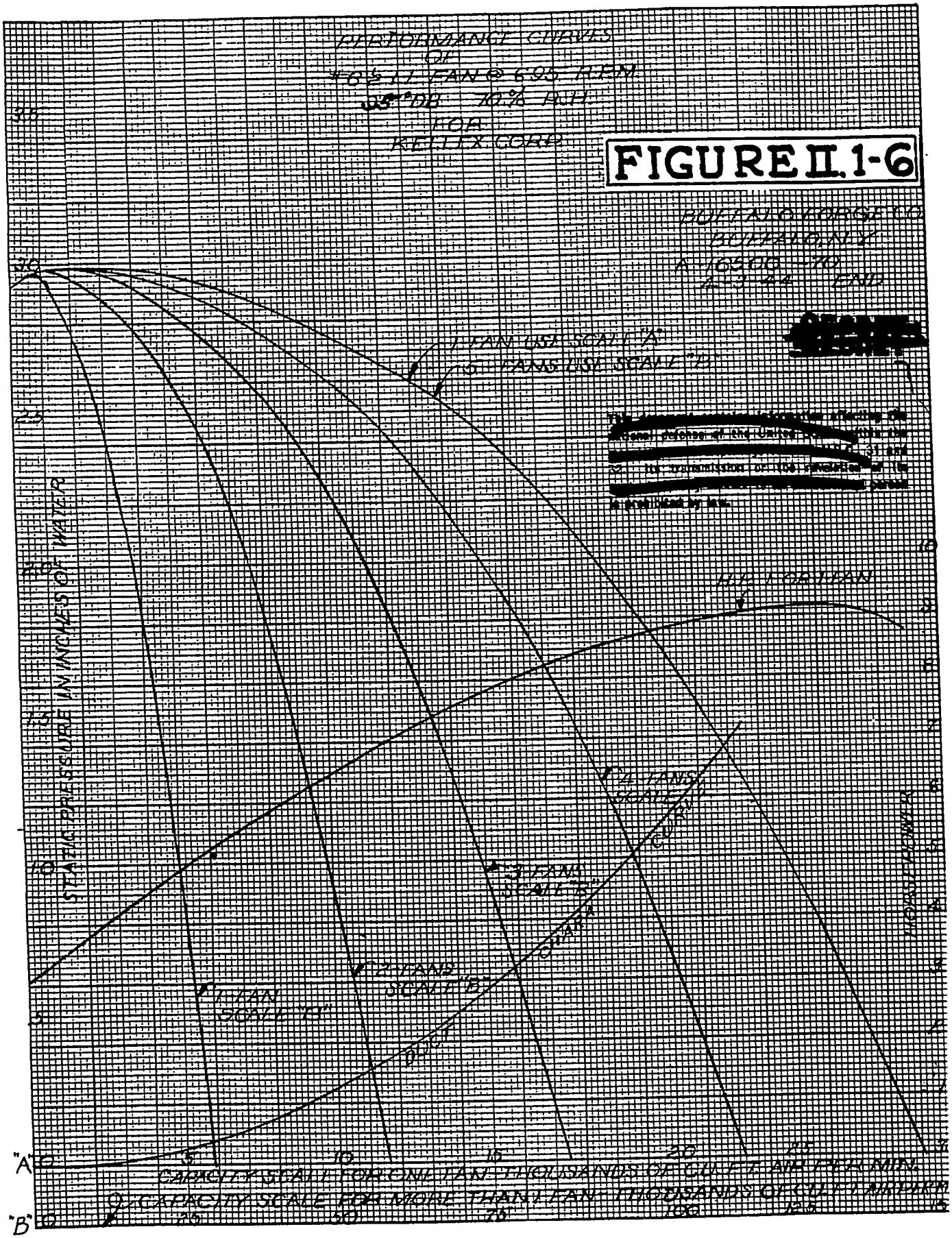

PERFORMANCE CURVE
OF
NO. 6 LI FANS @ 1066 R.P.M.
95 °DB 70% R.H.
FOR
KELLEX CORP.
OUTL. AREA 764 SQ.FT.
TIP SPEED 10175 FT/MIN
20 H.P. MIN.
BUFFALO FORGE CO.
BUFFALO, N.Y.
EST. No. 39329
4-25-44 @
H.P. FOR 1 FAN
5 FER. 1 FAN USE SCALE "A"
5 FANS USE SCALE "B"
4 FANS SCALE "B"
3 FANS SCALE "B"
2 FANS SCALE "B"
1 FAN SCALE "B"
HORSE POWER
STATIC PRESSURE INCHES OF WATER
CAPACITY SCALE FOR 1 FAN - THOUSANDS OF CU.FT. AIR PER MIN.
CAPACITY SCALE FOR MORE THAN 1 FAN - THOUSANDS OF CU.FT. PER MIN.

FIGURE II.1-5


PERFORMANCE CURVES
OF
#6½ I.I. FAN @ 695 R.P.M.
95° DB 70% R.H.
FOR
KELLEX CORP.
FIGURE II.1-6
BUFFALO FORGE CO.
BUFFALO, N.Y.
A-16500-70
4-3-44 END
[redacted]
1 FAN USE SCALE "A"
5 FANS USE SCALE "B"
H.P. FOR 1 FAN
4 FANS SCALE "B"
3 FANS SCALE "B"
2 FANS SCALE "B"
1 FAN SCALE "B"
DUCT CHARA CURVE
STATIC PRESSURE IN INCHES OF WATER
HORSEPOWER
"A"
"B"
CAPACITY SCALE FOR ONE FAN - THOUSANDS OF CU. FT. AIR PER MIN.
CAPACITY SCALE FOR MORE THAN 1 FAN - THOUSANDS OF CU. FT. AIR PER MIN.

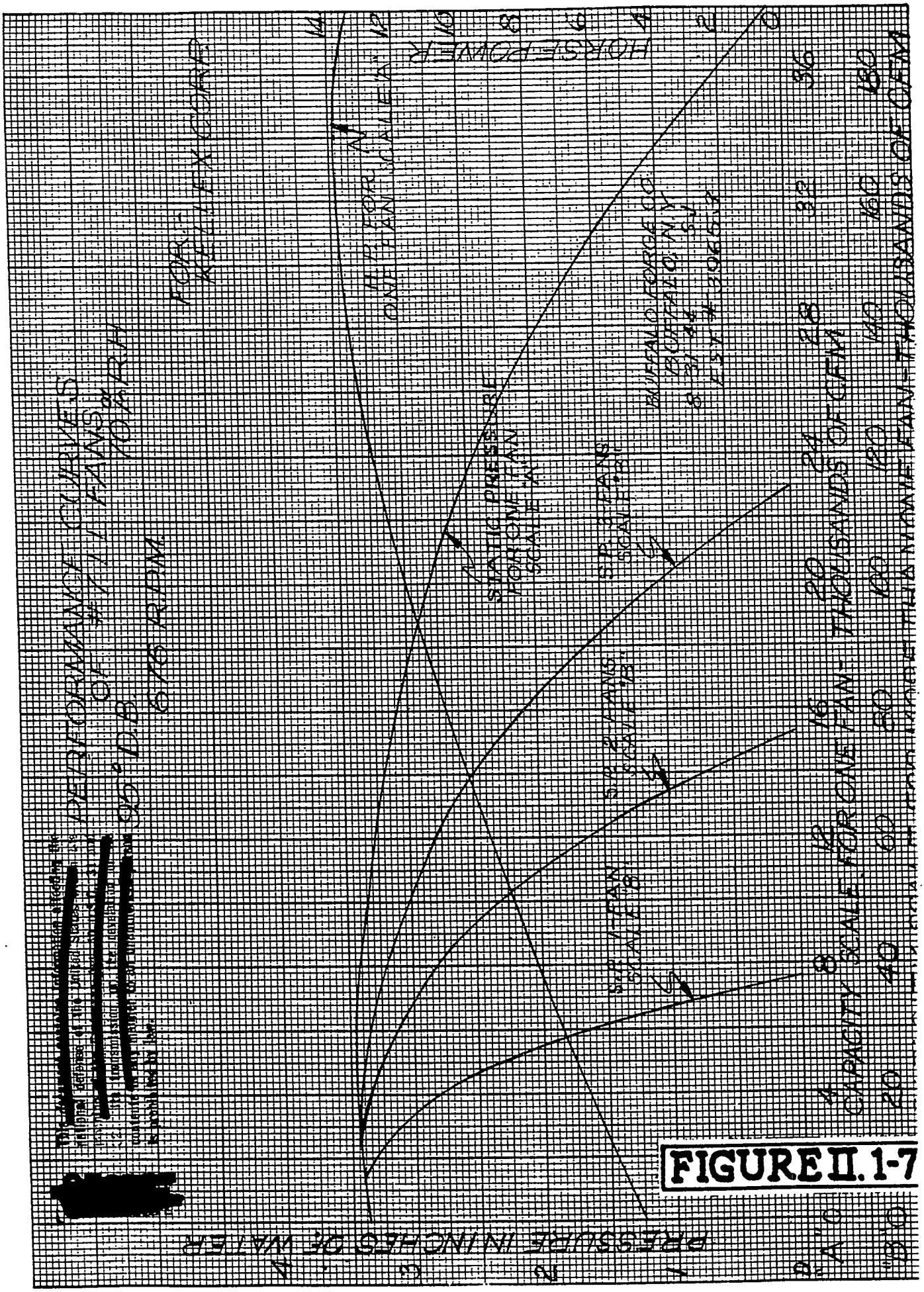
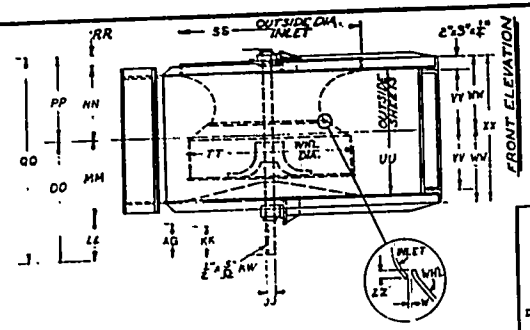
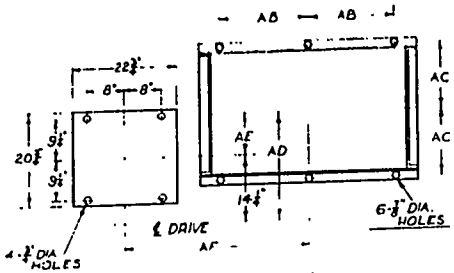

PERFORMANCE CURVES
OF #711 FANS
95° D.B.
676 R.P.M.
FOR KELLEX CORP.
H.P. FOR ONE FAN SCALE "A"
STATIC PRESSURE FOR ONE FAN SCALE "A"
S.P. 1-FAN SCALE "B"
S.P. 2-FANS SCALE "B"
S.P. 3-FANS SCALE "B"
BUFFALO FORGE CO.
BUFFALO, N.Y.
EST # 3965-3
HORSEPOWER
PRESSURE IN INCHES OF WATER
CAPACITY SCALE FOR ONE FAN - THOUSANDS OF CFM
"A" 0
"B" 0

FIGURE II. 1-7

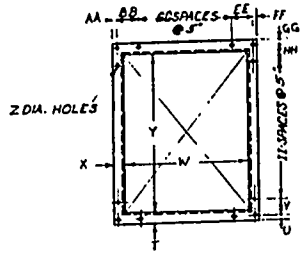
[redacted]

NO.15-48589-A





PLAN

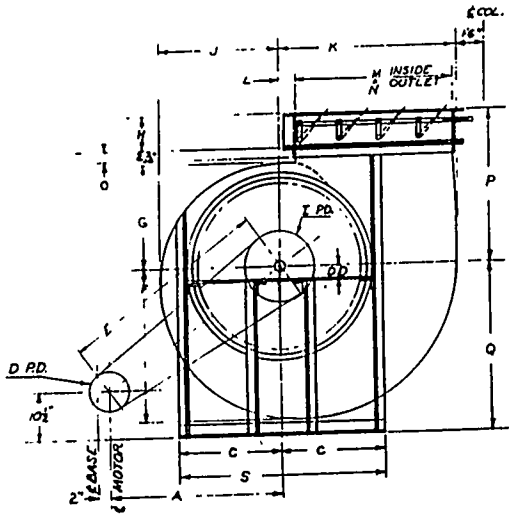


DETAIL OF DRILLING OUTLET & OUTLET DAMPER

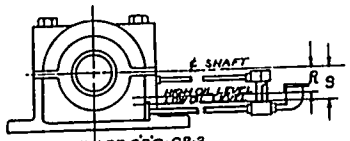
B.F. STURTEVANT COMPANY #90 SILENTVANE) DESIGN # 7
#100 SILENTVANE)

DIM. INCHES	#90	#100	DIM. INCHES	#90	#100	DIM. INCHES	#90	#100	DIM. INCHES	#90	#100
A	38 1/4	49 5/8	P	32 1/4	37 5/16	EE	4 13/16	5 1/2	TT	36 1/4	44°
B	46 1/2	53	Q	36 1/4	42 1/2	FF	7/8	1 1/8	UU	27 3/8	33 1/4
C	23 1/4	26 1/2	R	1 15/16	2 1/8	GG	7/8	1 1/8	VV	13 9/16	16 1/4
D	8.6	7.4	S	2 5/16	2 9/16	HH	3 1/2	5 5/16	WW	15 9/16	18 1/4
E	46.1	59.1	T	2	2 1/2	II	6	7	XX	31 1/8	36 1/2
F	32 7/16	39	U	7/8	1 1/8	JJ	1 15/16	2 3/16	YY	1/8	5/32
G	22 13/16	27 5/16	V	3 1/2	5 5/16	KK	5 1/4	5 3/4	ZZ	1/4	5/16
H	7	8	W	27 3/8	44 1/4	LL	9 1/2	10 7/16	AB	19	22
I	15.4	18.4	X	2	2 1/2	MM	16 3/16	18 1/2	AC	14 11/16	17 3/8
J	26 3/16	31 3/8	Y	34 3/4	43 7/8	NN	16 3/16	18 1/2	AD	23 1/2	26 1/2
K	39 9/16	47	Z	28-7/16°	32-9/16°	OO	25 11/16	28 15/16	AE	9 1/4	12 1/4
L	3 7/8	4 1/8	AA	7/8°	1 1/8°	PP	20 5/16	22 3/16	AF	40 1/4	51 5/8
M	34 3/4	43 7/8	BB	4 13/16	5 1/2	QQ	46	51 3/4	AG	6	6 3/4
N	27 3/8	33 1/4	CC	4	5	RR	4 1/8	4 5/16			
O	2x2x1/4	2x2½x1/4	DD	3 1/2	5 5/16	SS	39 3/4	46 1/8			

[redacted]



SIDE ELEVATION



END VIEW OF BRG-GR-2 SHOWING DETAIL OF OIL GAUGE

NO.	DESCRIPTION	DATE	BY	CHECKED

REVISIONS

FIGURE II.1-8

THE KELLEX CORPORATION

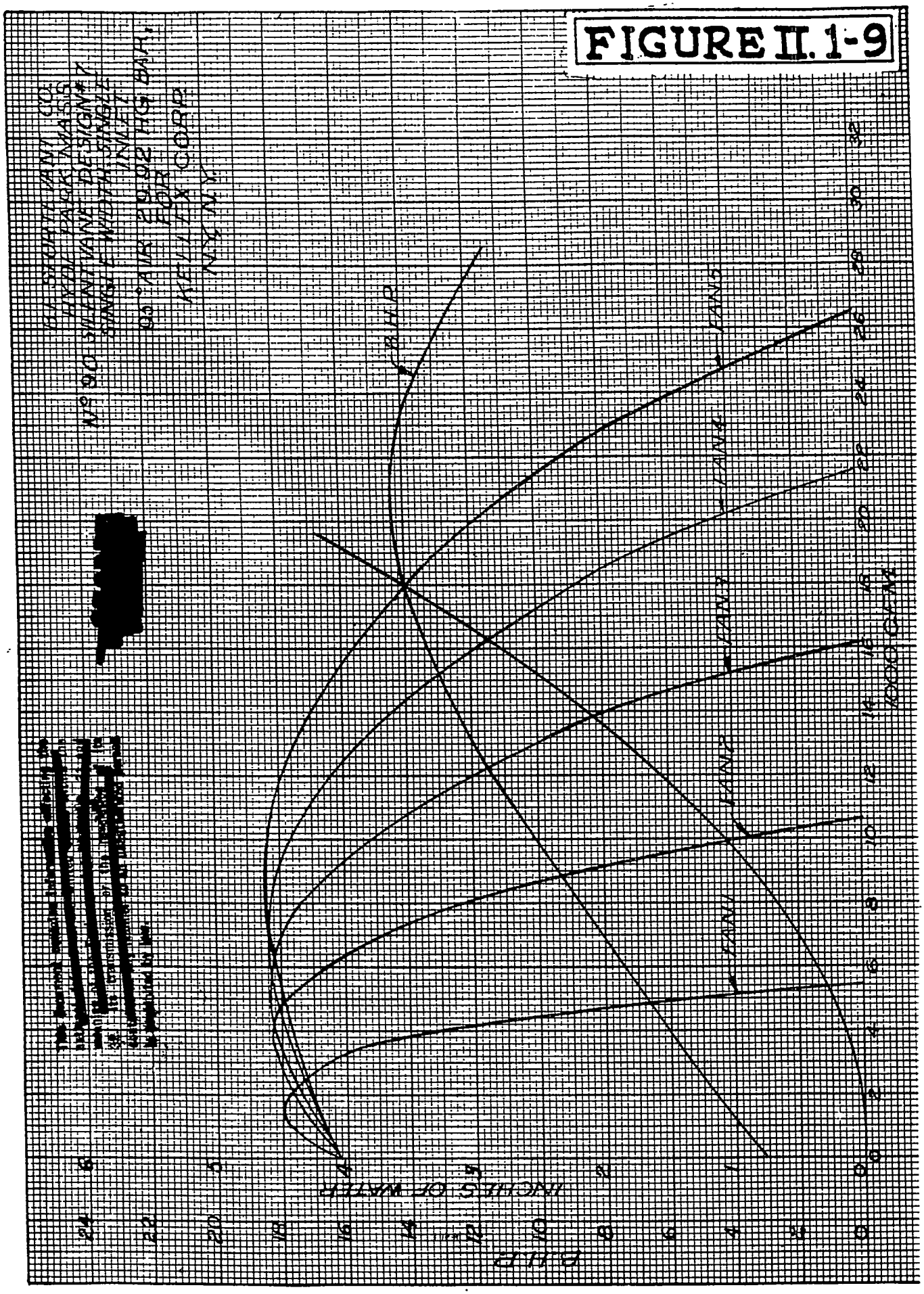
#90 & 100 SILENTVANE FAN DES-7
WITH SEMI-AUTOMATIC DAMPER

FOR

DRAWN _____ TRACED _____ SCALE _____ DATE _____
CHECKED _____
APPROVED _____

No. 15-48589-A

FIGURE II. 1-9



B.L. STORTEVANT CO.
HYDE PARK, MASS.
Nº 90 SILENTVANE DESIGN #7
SINGLE WIDTH SINGLE INLET
95° AIR 29.92 HG BAR.
FOR
KELLEX CORP.
N.Y. N.Y.
B.H.P.
FAN 1
FAN 2
FAN 3
FAN 4
FAN 5
1000 CFM
INCHES OF WATER
B.H.P.

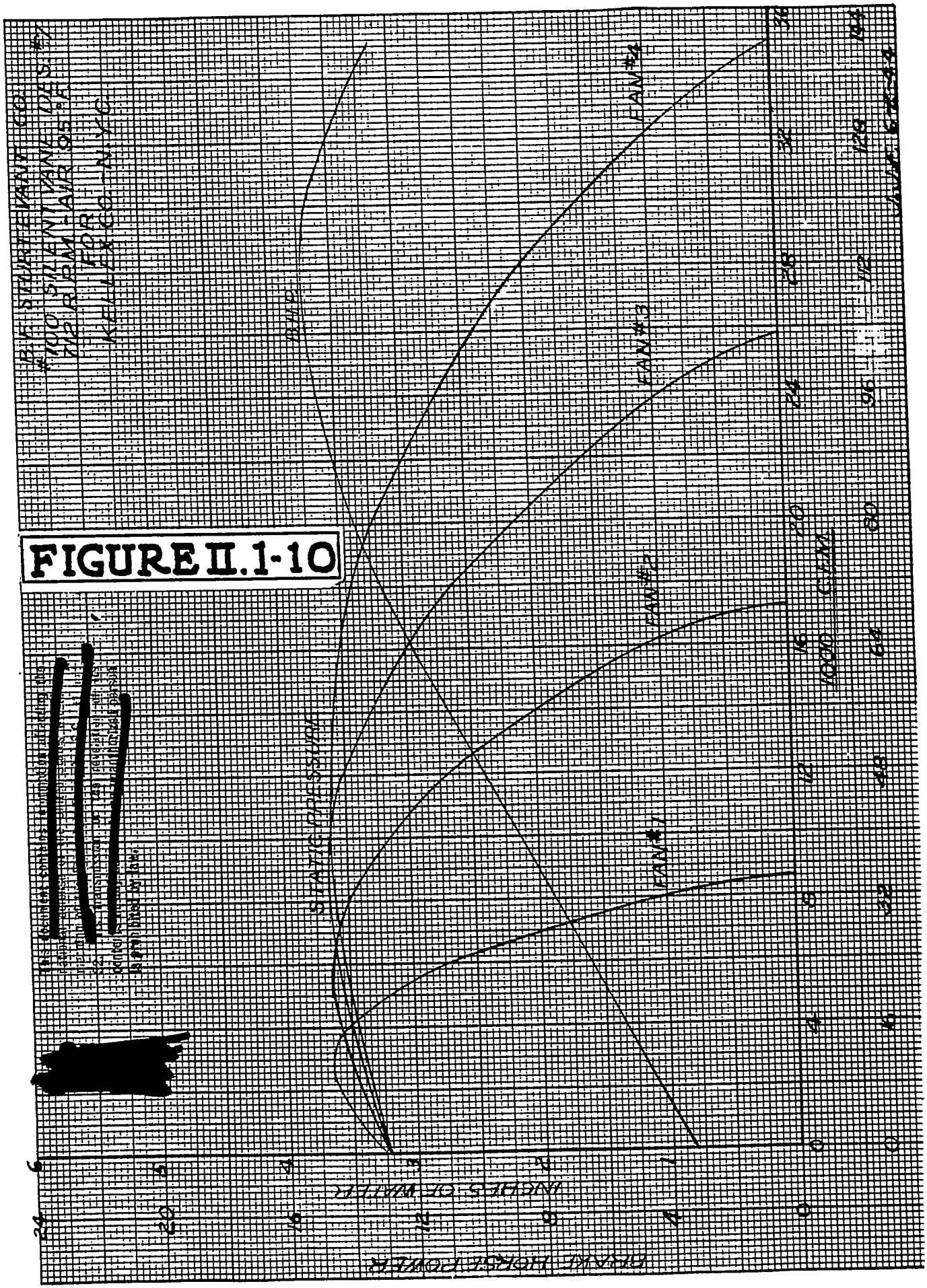
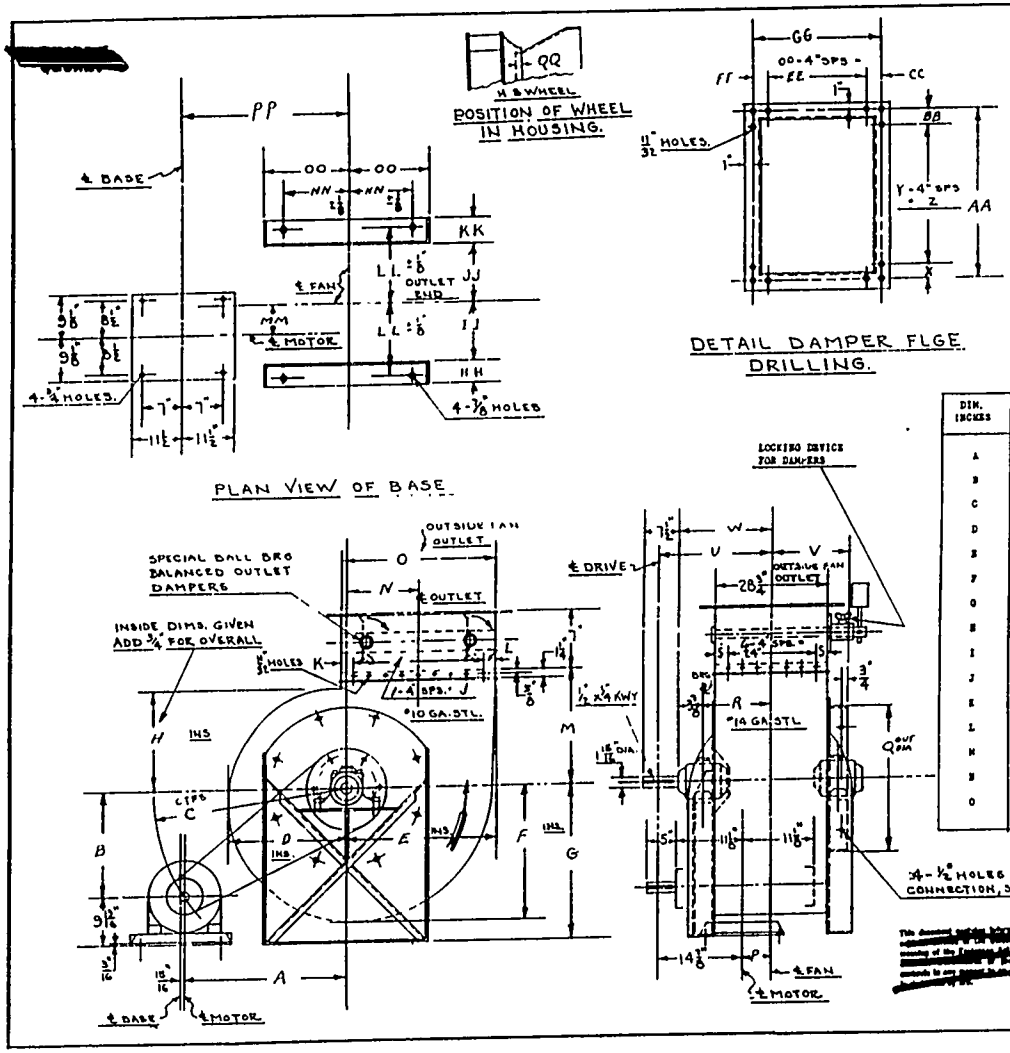


FIGURE II.1-10

[redacted]

[redacted]



AMERICAN BLOWER CO.
#5 1/2 and #6 H.S. FANS
ARR'T #3.

FIGURE II.1-11

AMERICAN BLOWER CO. FANS #5 1/2 & #6

DIM. INCHES	#5 1/2	#6	DIM. INCHES	#5 1/2	#6	DIM. INCHES	#5 1/2	#6
A	38 5/16	38 9/16	P	8 5/8	9 3/4	XX	20	24
B	24 3/16	27 3/16	Q	34 3/4	37 3/4	YY	4 3/16	3 1/8
C	45.3	47.2	R	15 1/4	16 7/16	OO	28 3/8	30 1/4
D	24 11/32	26 9/16	S	1 3/16	2 3/8	HH	4 3/4	5
E	32 7/16	35 3/8	T	26 3/8	28 3/4	II	13 1/4	14 7/16
F	27 27/32	30 3/8	U	23 1/2	24 5/8	JJ	13 1/4	14 7/16
G	34	37	V	17	18 3/16	KK	4 3/4	5
H	20 21/32	22 17/32	W	19 1/8	20 5/16	LL	16 1/2	18
I	7	8	X	3 9/16	3 1/16	MM	8 5/8	9 3/4
J	28	32	Y	7	8	NN	15	16 1/2
K	2 9/16	2 1/16	Z	28	32	OO	19 1/4	21
L	2 9/16	2 1/16	AA	35 1/8	38 1/8	PP	39 1/4	39 1/2
M	24 3/8	26 1/4	BB	3 9/16	3 1/16	QQ	17/32	19/32
N	15 15/16	17 3/8	CC	4 3/16	3 3/8			
O	33 1/8	36 1/8	DD	5	6			

CUSTOMERS ORDER No. 8189

AMERICAN BLOWER CORPORATION
DETROIT 32, MICHIGAN

Drawing of
For THE KELLEX CORP. DIST. ENGR. CLINTON ENGR. WORKS
At PLAIN, TENNESSEE
Customer

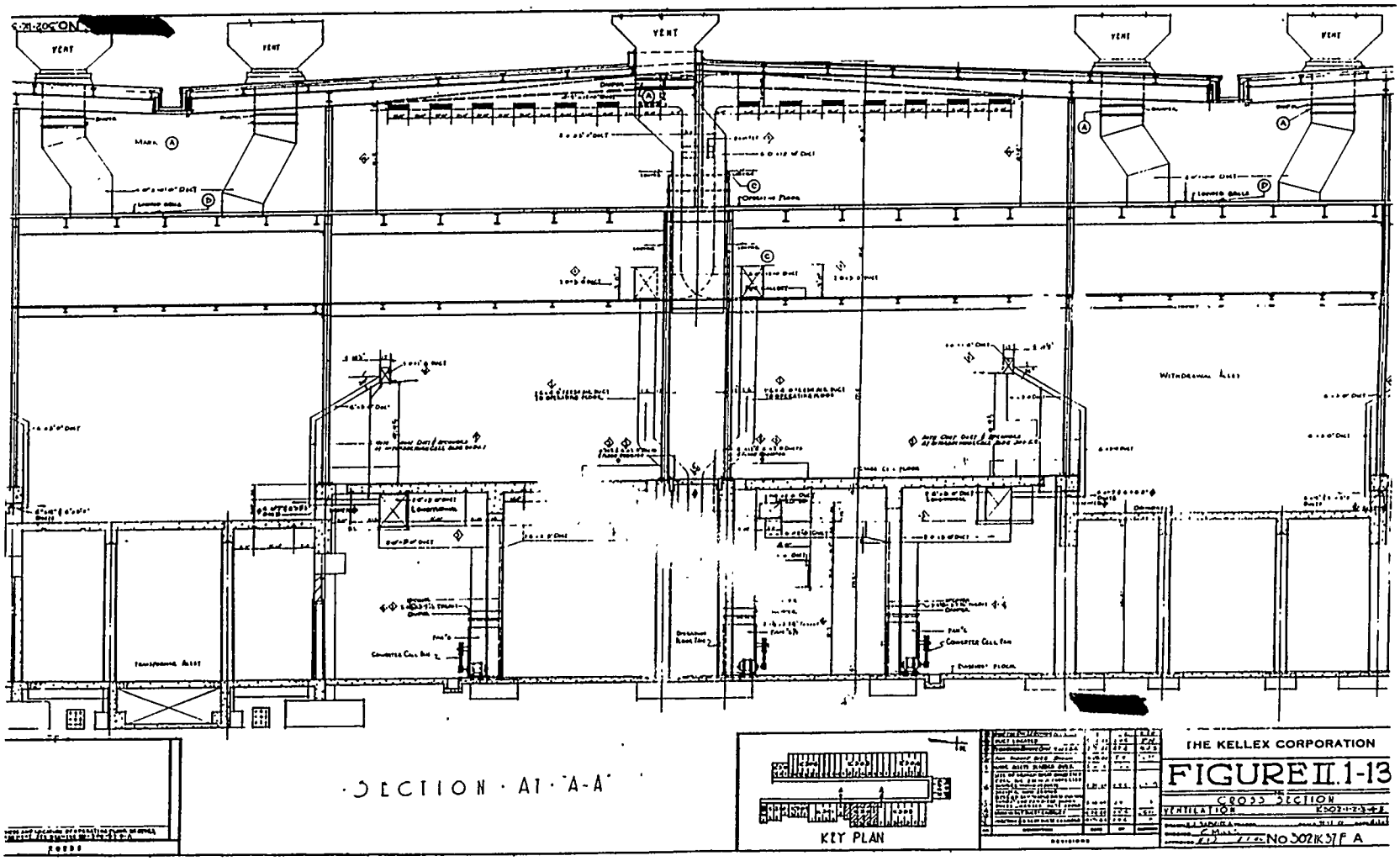
Drawing No. H-69632
Order No. 17830
Scale none Date 8-8-49

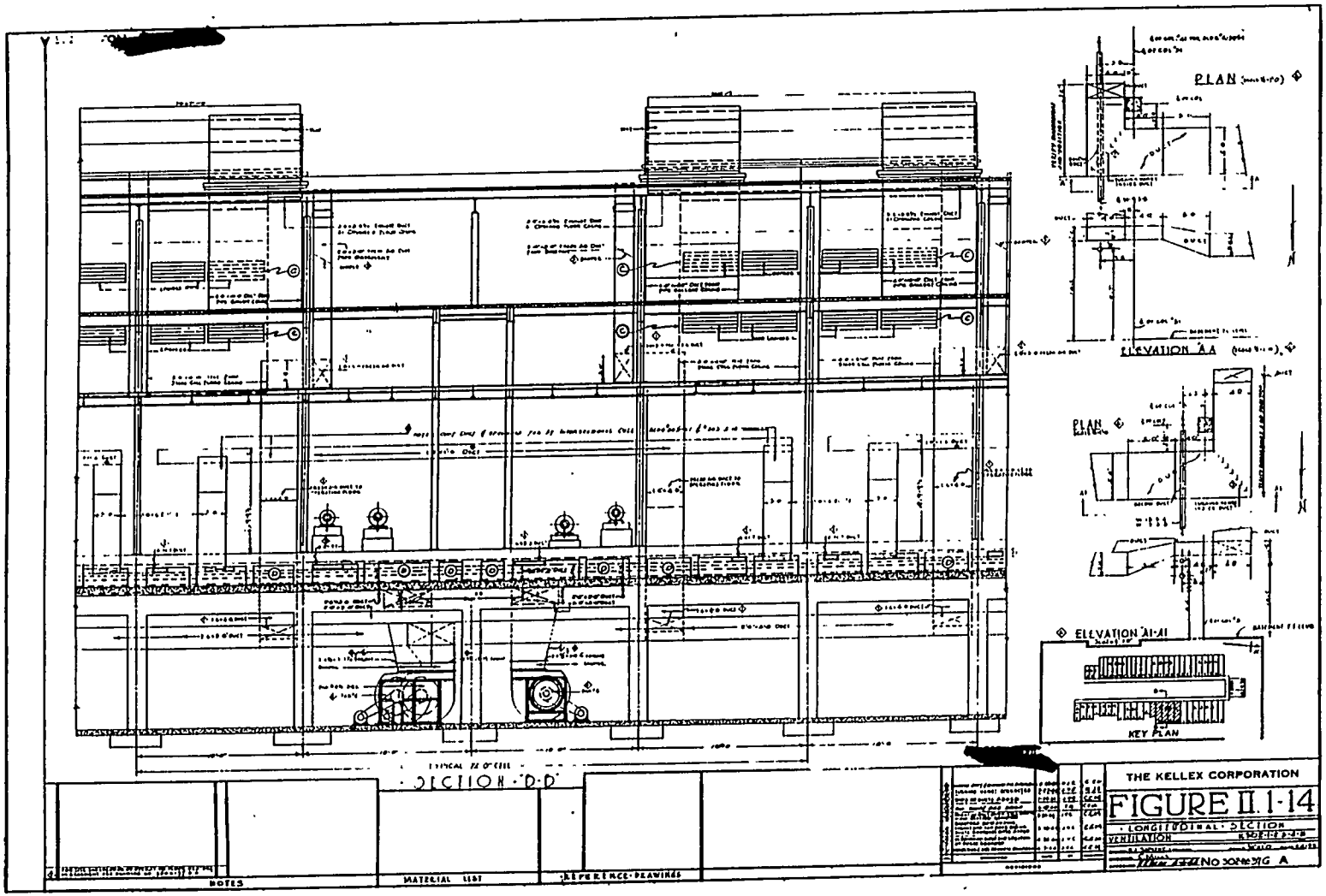
Drwn. H. C. R.
Chkd. RD.
Appd.
Appd.

[redacted]

[redacted]

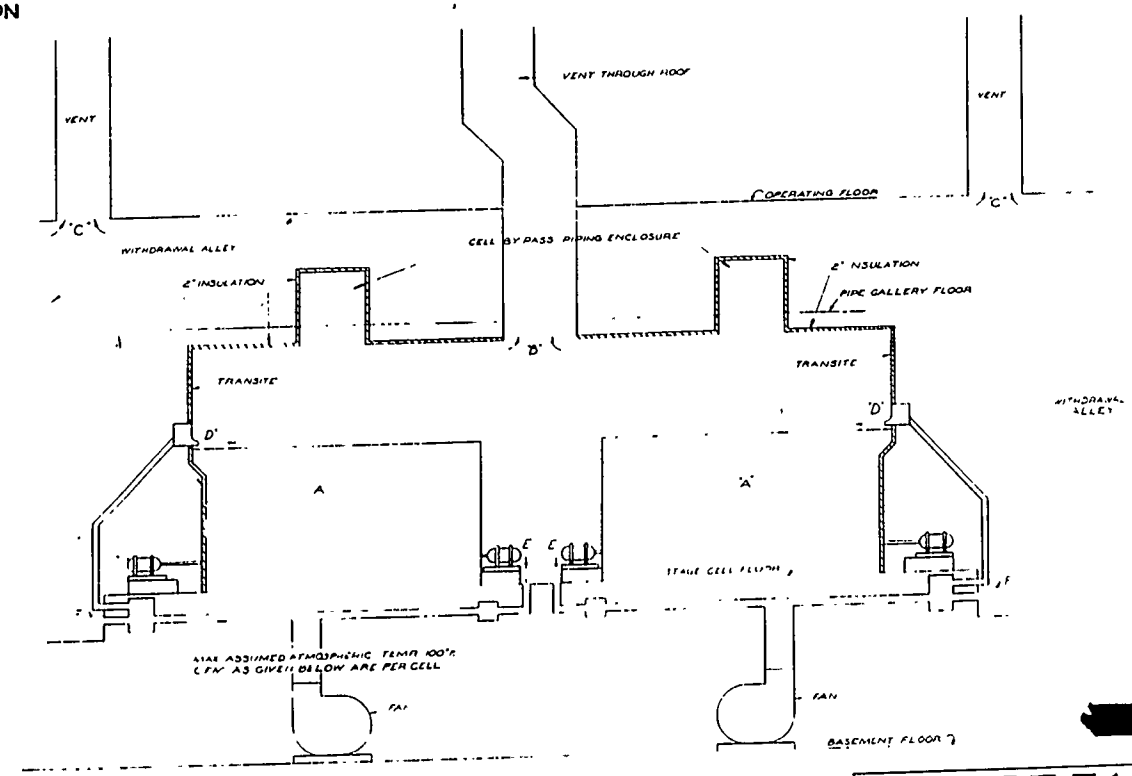
FIGURE II. 1-12


VENT
VENT
VENT
VENT
VENT
WITHDRAWAL ALLEY
TRANSFORMER ALLEY
SECTION AT A-A
KEY PLAN
THE KELLEX CORPORATION
FIGURE II.1-13
CROSS SECTION
VENTILATION
NO 302K37 F A


PLAN
ELEVATION A-A
PLAN
ELEVATION A1-A1
KEY PLAN
SECTION D-D
NOTES
MATERIAL LIST
REFERENCE DRAWINGS
THE KELLEX CORPORATION
FIGURE II.1-14
LONGITUDINAL SECTION
VENTILATION

NO.SK-300-K D-2

[redacted]



[redacted]

CHECK	A_c	B_c	C_p	D	E	F
	F	F	F	C.F.M.	C.F.M.	C.F.M.
-1	145	120	110	5000	6000	6000
-2	137	120	110	6000	7000	11000
-3	137	130	110	6500	7000	12000
-4	137	130	110	6500	7000	12000
-5	137	120	110	6000	7000	11000
-6	137	120	110	6000	7000	11000
-7	137	120	110	6000	7000	11000
-8	137	120	110	6000	7000	11000
-9	137	120	110	6000	7000	11000
-10	137	120	110	6000	7000	11000
-11	137	120	110	6000	7000	11000
-12	137	120	110	6000	7000	11000
-13	137	120	110	6000	7000	11000
-14	140	110	110	6000	6000	5000
-15	137	110	110	6000	6000	6000
-16	128	105	110	3500	3500	3500

[redacted]

NO	DESCRIPTION	DATE	BY	APPROVED

REVISIONS

FIGURE II.1-15

THE KELLEX CORPORATION

TYP CROSS SECTION SHOWING VENTILATION

DRAWN ____ TRACED ____ SCALE ____ DATE ____
CHECKED ____
APPROVED ____

NO. SK-300-KD-2

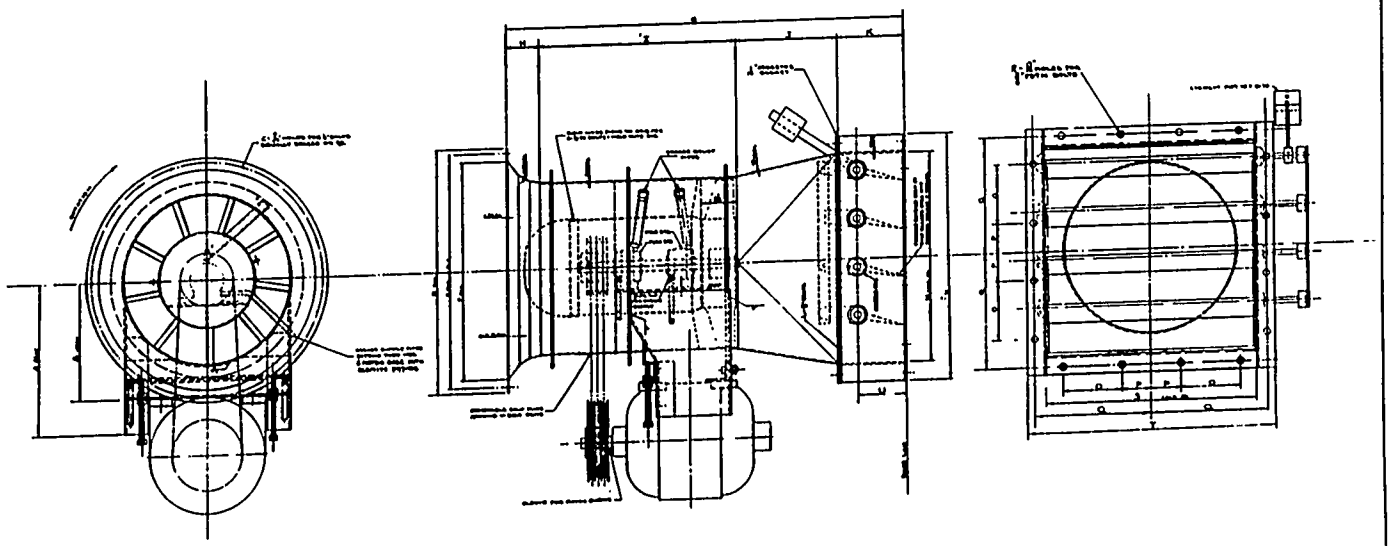


FIGURE II.1-16

[redacted]

BW-3115

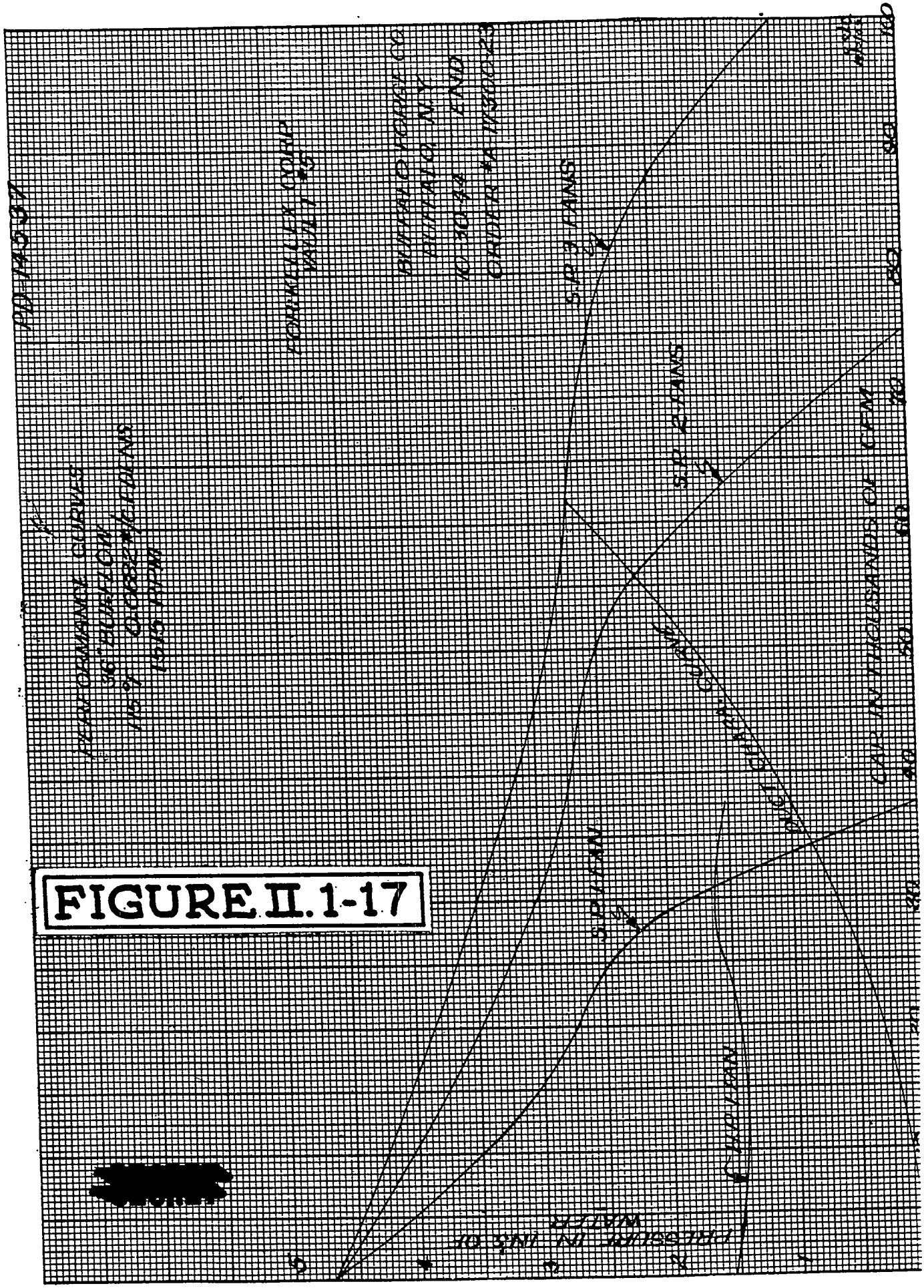
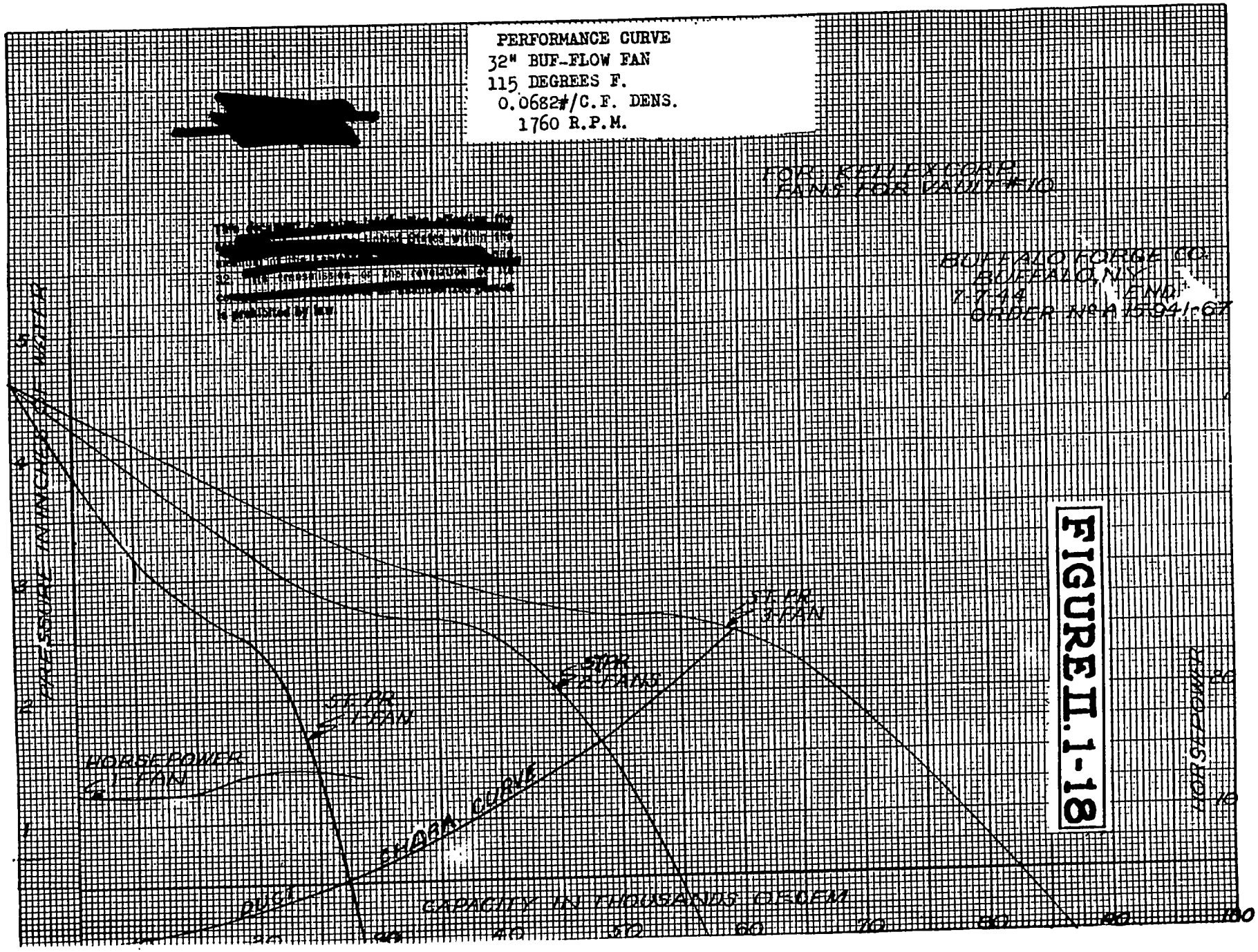


FIGURE II.1-17

[redacted]


PERFORMANCE CURVE
32" BUF-FLOW FAN
115 DEGREES F.
0.0682#/C.F. DENS.
1760 R.P.M.
[redacted]
FOR KELLY-CORP
FANS FOR UNIT #10
BUFFALO FORGE CO.
BUFFALO, N.Y.
7-7-44
ORDER NO. A 15941-67
FIGURE II.1-18
HORSEPOWER
1-FAN
2-FAN
3-FAN
STOP
2-FANS
CURVE
DUST
CAPACITY IN THOUSANDS CFSCFM
HORSEPOWER MINIMUM
HORSEPOWER STOP
0
10
20
30
40
50
60
70
80
90
100

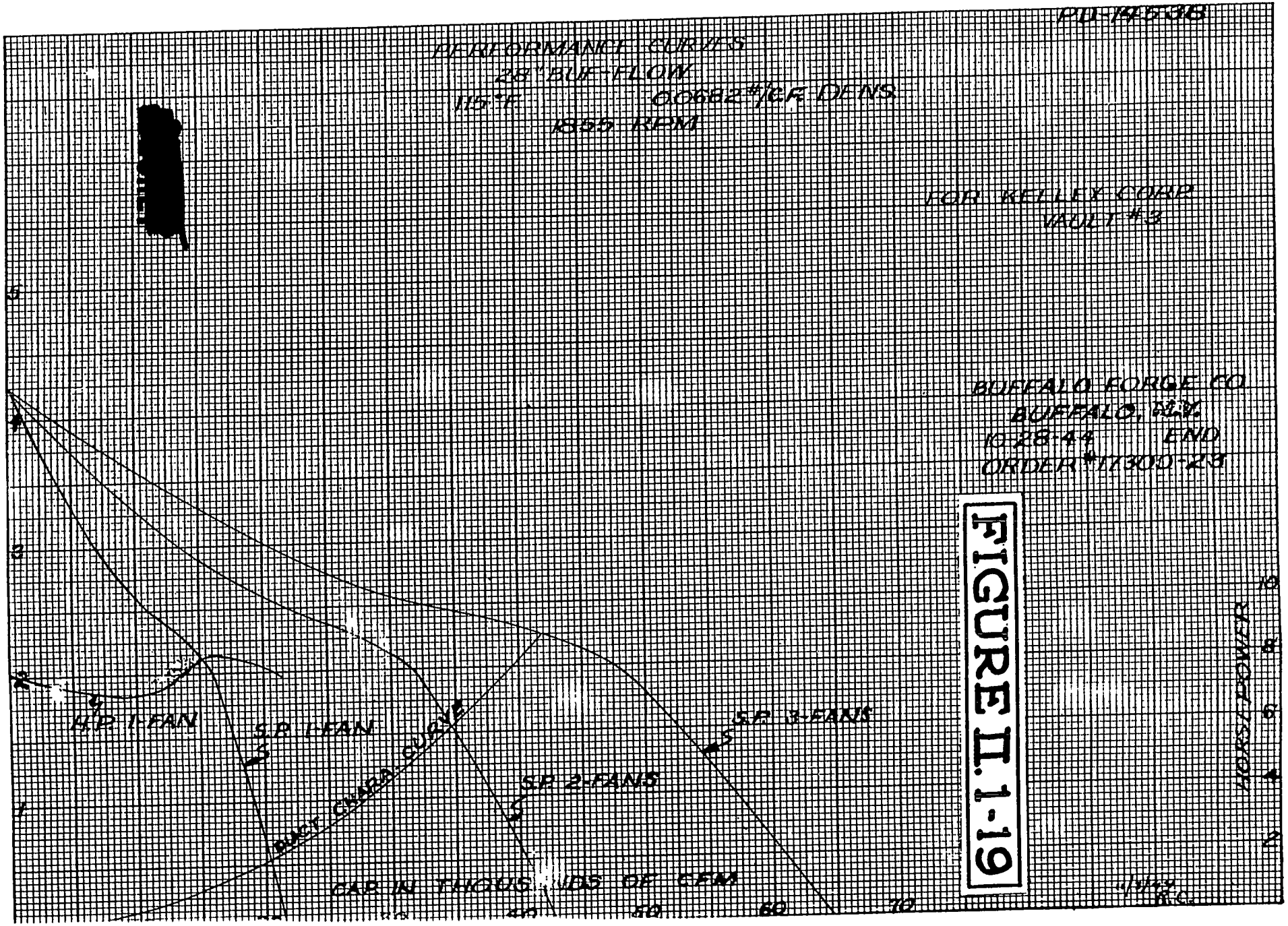


FIGURE II.1-19

[redacted]

FIGURE II.1-20

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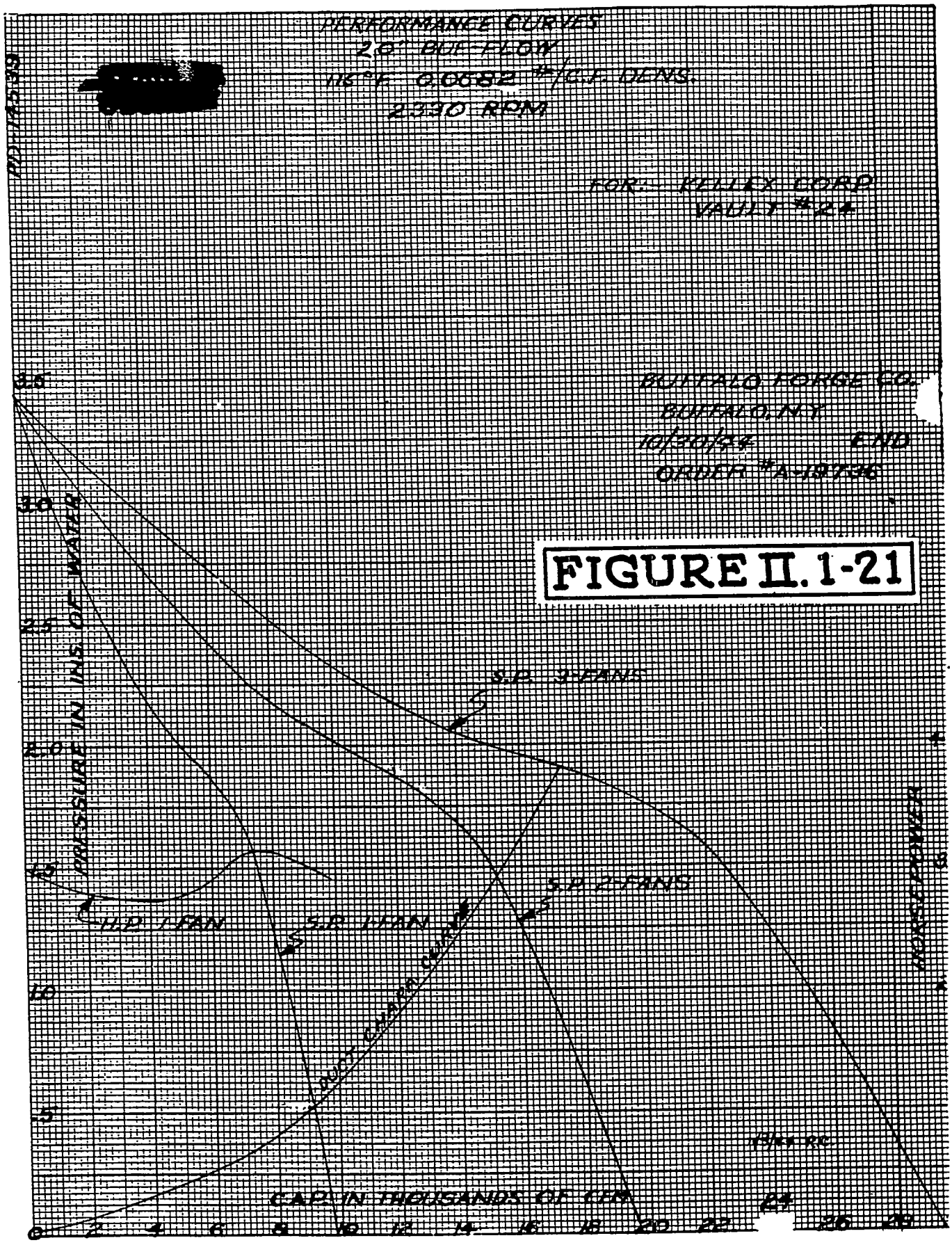
PERFORMANCE CURVES
20" DUF-FLOW
116°F 0.0682 #/C.F. DENS.
2330 RPM
[redacted]
FOR:- KELLEX CORP
VAULT #24
BUFFALO FORGE CO.
BUFFALO, N.Y.
10/20/54
ORDER #A-19736
FIGURE II. 1-21
PRESSURE IN INS. OF WATER
3.5
3.0
2.5
2.0
1.5
1.0
.5
0
S.P. 3-FANS
S.P. 2-FANS
S.P. 1-FAN
HP. 1-FAN
DUCT CHARACTERISTIC CURVE
BHP. RC
CAP. IN THOUSANDS OF CFM
2
4
6
8
10
12
14
16
18
20
22
24
26
28

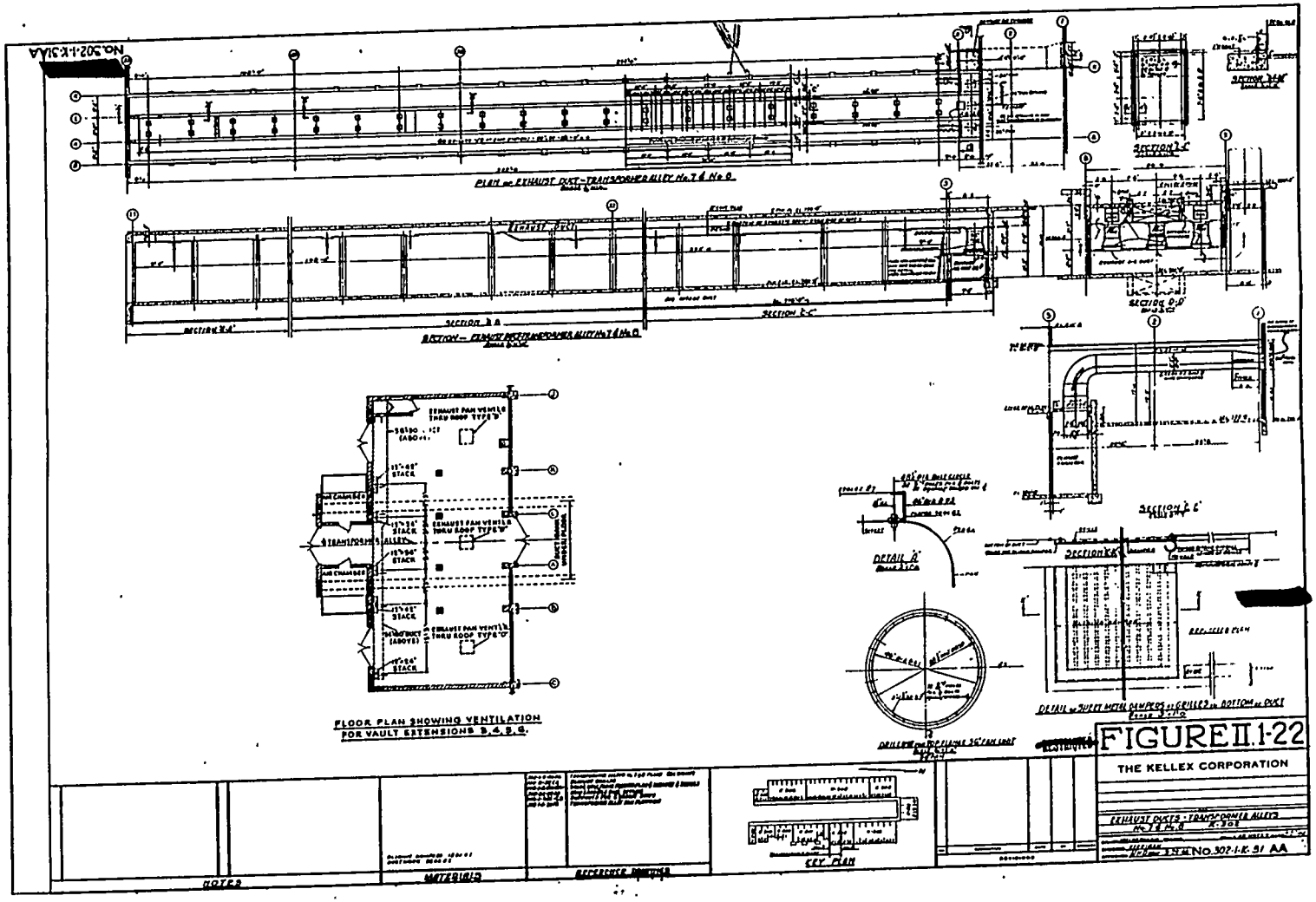

FIGURE II.1-22

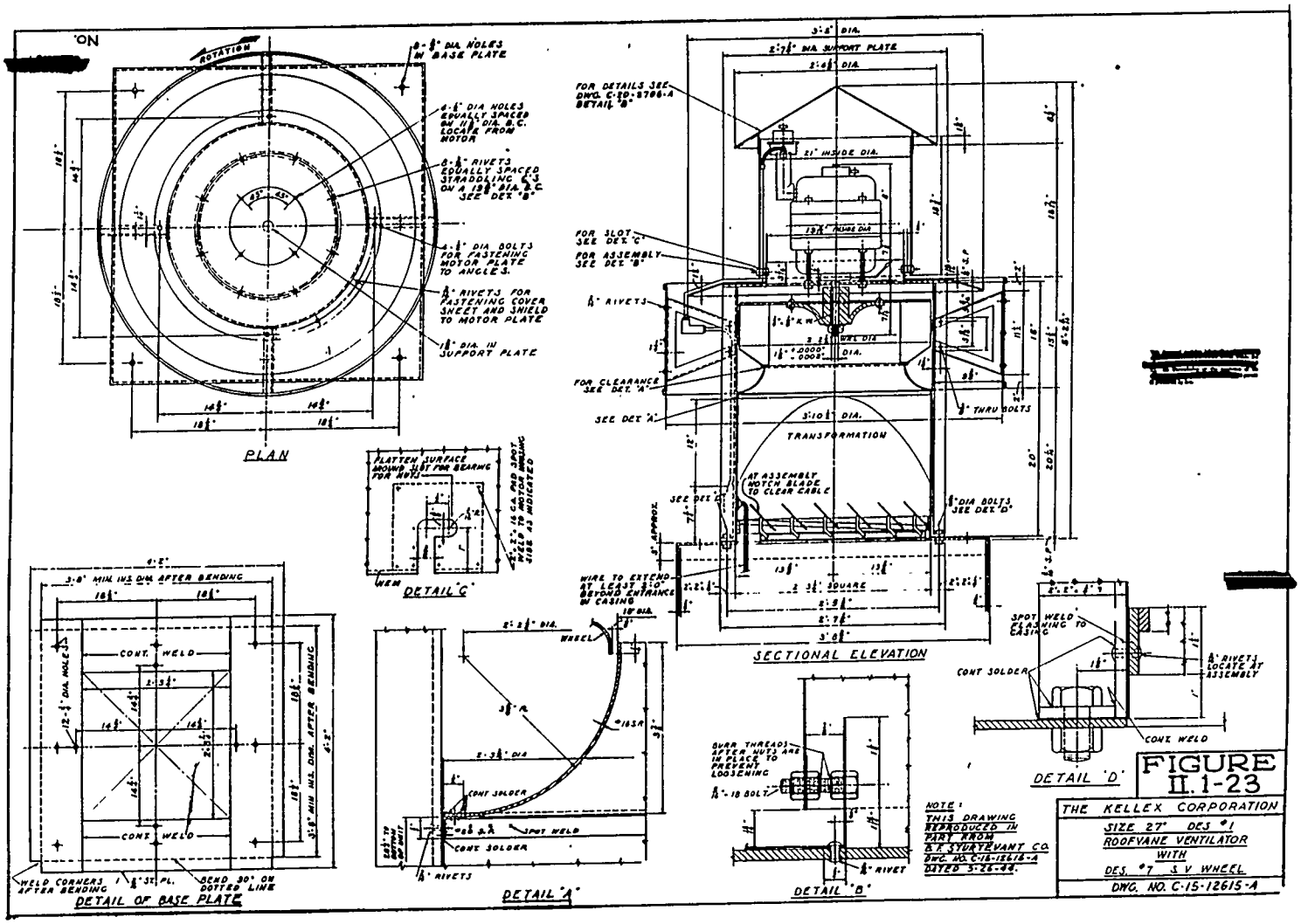

FIGURE II.1-23

FIGURE II.1-24

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2. ChemRisk/Shonka Research Associates

3. DOE Public Reading Room

4. S. G. Thornton (K-25 EMD)