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TABLE OF CONTENTS

	<u>PAGE</u>
1.0 INTRODUCTION	1-1
2.0 PRINCIPLES OF RESPIRABLE DUST CONTROL	2-1
2.1 PREVENTING OR LIMITING DISPERSION	2-2
2.2 DILUTING WITH AIR	2-3
2.3 VENTILATING CORRECTLY	2-4
3.0 MINE WATER SUPPLY SYSTEM	3-1
3.1 MINE SUPPLY	3-2
3.2 WATER TREATMENT	3-5
3.3 SPRAY NOZZLES	3-12
4.0 MINE VENTILATION SYSTEM	4-2
4.1 EXHAUST TUBING	4-5
5.0 DETAILED DESCRIPTIONS OF ENGINEERING METHODS USED TO CONTROL RESPIRABLE COAL DUST	5-1
5.1 CONVENTIONAL MINING	5-2
5.1.1 CUTTING MACHINES	5-3
5.1.2 LOADING MACHINES	5-5
5.1.3 COAL DRILLS	5-7
5.1.4 COAL BLASTING	5-7
5.2 CONTINUOUS MINERS	5-9
5.2.1 BORING MINERS	5-10
5.2.1.1 BORERS	5-10
5.2.1.2 MULTIPLE ARM BORER (COLMOL)	5-18
5.2.2 MILLING MACHINES	5-22
5.2.3 RIPPING-TYPE CONTINUOUS MINERS	5-27
5.2.4 AUGER-TYPE MINER	5-33
5.3 LONGWALL MINING	5-38
5.4 MISCELLANEOUS	5-42
5.4.1 HAULAGE DUST	5-43
5.4.2 ROOF DRILLS	5-47
5.4.3 UNDERGROUND CRUSHERS AND SCREENS	5-48

LIST OF FIGURES

<u>FIGURE</u>		<u>PAGE</u>
4-1	SINGLE SPLIT VENTILATION SYSTEM FOR 5 ENTRY PANEL DEVELOPMENT	4-3
4-2	DOUBLE SPLIT VENTILATION SYSTEM FOR 5 ENTRY PANEL DEVELOPMENT	4-4
5-1	EXHAUSTING FACE VENTILATION SYSTEM	5-4
5-2	CUTTING MACHINE WATER OUTLET LOCATIONS	5-4
5-3	EXHAUSTING FACE VENTILATION SYSTEM FOR LOADING MACHINE	5-6
5-4	SPRAY LOCATION ON LOADING MACHINE	5-6
5-5	COAL DRILL FITTED FOR WET DRILLING	5-8
5-6	TYPICAL FACE PATTERN CUT BY TWIN BORER	5-10
5-7	GENERAL ARRANGEMENT OF LINE CURTAIN ON OPERATORS SIDE	5-13
5-8	SKETCH OF LINE CURTAIN TRANSITION AT CORNER OF CROSS-CUT	5-14
5-9	TWIN BORING MACHINE (FULL FACE)	5-15
5-10	FACE VENTILATION SYSTEM (TWIN BORING MACHINE) FULL FACE	5-16
5-11	SCHEMATIC OF VENTILATION ARRANGEMENT ON MARIETTA TWIN BORER IN PITTSBURGH SEAM USING TWO EXHAUST FANS AND ONE DIFFUSER FAN	5-17
5-12	BLOWING VENTILATION SYSTEM	5-19
5-13	EXHAUST BRATTICE	5-20
5-14	EXHAUST BRATTICE AND DIFFUSER FAN	5-21
5-15	EXHAUST BRATTICE (OSCILLATING HEAD MILLING MINER)	5-23
5-16	EXHAUST FAN SYSTEM (NON OSCILLATING HEAD MILLING MINER)	5-24
5-17	GENERAL ARRANGEMENT OF EXPERIMENTAL SCRUBBER MOUNTED ON JOY 10CM	5-28

<u>FIGURE</u>		<u>PAGE</u>
5-18	SPRAY NOZZLE ARRANGEMENT ON HEAD OF JOY 10 CM MINER	5-29
5-19	SPRAY NOZZLE ARRANGEMENT ON JOY 10 CM MINER PAN	5-30
5-20	EXHAUST BRATTICE	5-32
5-21	FACE VENTILATION SYSTEM (AUGER TYPE MINER)	5-35
5-22	FACE VENTILATION SYSTEM (AUGER TYPE MINER)	5-36
5-23	LONGWALL VENTILATION SYSTEM	5-41
5-24	BELT TRANSFER POINT	5-44
5-25	LOADING HEAD	5-44
5-26	WIRE BRUSH CLEANER	5-45
5-27	ROTATING BRUSH	5-45
5-28	BELT BEATER	5-46
5-29	UNDERGROUND HOOD AND DUCT COLLECTION SYSTEM FOR A CRUSHER AND SCREEN	5-49

<u>TABLE</u>		<u>PAGE</u>
3-1	FRICTION OF WATER IN PIPES	3-3
3-2	PRESSURE EQUIVALENTS	3-4
4-1	RESISTANCE CHART	4-6
5-1	JOY 10 CM SPRAY SYSTEM NOZZLES	5-31

1.0 INTRODUCTION

This manual has been prepared for the help and guidance of underground coal mine operators. It details both common and unique engineering methods by which the respirable dust, which is generated in coal mines, can be controlled.

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The authors wish to express their appreciation to the operators and employees of those underground coal mines visited during the performance of this study. Their wholehearted cooperation made this manual possible. We further wish to thank Dr. Welby G. Courtney and his staff of the Bureau of Mines at Bruceton, Pennsylvania for their help and guidance.

Pittsburgh, Pennsylvania
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2.0 PRINCIPLES OF RESPIRABLE DUST CONTROL

There are five basic principles that are used to control or reduce respirable coal mine dust:

- (a) prevent or limit dispersion
- (b) dilute with air
- (c) ventilate correctly
- (d) prevent generation
- (e) provide self protection

The scope of this manual, and the control methods described herein will be concerned with the first three items only.

The science of prevention of generation of respirable dust in mining coal is not advanced enough at this time to recommend procedures whose effectiveness has been documented. The use of self protection devices, such as; nose and mouth respirators, full face respirators, fresh air masks, etc., are not currently considered as respirable dust control solutions under the Act. They should be used where temporary high dust conditions exist, however long term control of dust should be accomplished by methods such as described in this manual.

Two instruments have recently become available which enable the operator to quickly check the effectiveness of a dust control method. They can be very helpful in evaluating changes in control methods or procedures without the necessity of taking an eight-hour gravimetric personal sample. These instruments are available from the following two concerns:

1. GCA Corporation
Bedford, Massachusetts 01730
Price: approximately \$2,750.00

2. American Brattice Cloth Corporation
P. O. Box 187
Warsaw, Indiana 46580
Price: approximately \$1,650.00

2.1 PREVENTING OR LIMITING DISPERSION

The methods used to control respirable dust dispersion can vary depending upon how the dust is generated. The following table lists the different sources of generation and the common methods employed to limit dust dispersion.

<u>Source of Generation</u>	<u>Common Methods of Limiting Dispersion</u>
1. Coal extraction	Water spray Water & wetting agent spray Water infusion of face Sprays & exhaust ducting
2. Drilling blast holes	Water injection through hollow drill
3. Blasting	Stemming with water bags Stemming with air bags Water infusion of face Compressed air blasting
4. Roof drills	Dry dust collection
5. Haulage	Sprays at transfer points Enclosing transfer points Exhausting transfer points Spraying or foaming top of haulage cars
6. Underground crushers & screens	Exhaust duct system

2.2 DILUTING WITH AIR

No method of preventing or limiting dust dispersion at the source of generation is 100% effective, particularly at the face. It therefore becomes mandatory to supply diluting air in sufficient quantity to reduce the amount of respirable dust concentration below the established limits of 2 mg/m³ of air. Any given volume of dust laden air will have its concentration of dust reduced proportionally by increasing the volume of air within which the dust is contained. The minimum legal requirement of 3000 cfm at each working place has proven to be an acceptable minimum for effective dust control. Volumes can be greater. However, care must be taken not to increase volumes so high that air velocity will pick-up dust from the workings and create a larger dust problem than that caused from normal operations. It is generally conceded that air velocities in excess of 400 ft./min. will generate additional dust concentration from the walls and floor of the workings.

2.3 VENTILATING CORRECTLY

The foregoing methods of limiting dispersion and providing diluting air are two of the essential parts of an effective dust control system. The third and equally important ingredient is proper control and direction of the diluting air. This is particularly true in the face areas. A properly established exhausting ventilation system will move fresh air past the breathing zone of the face workers, across the face (where dust is generated) and out of the working place to the return entries. This creates an environment of the lowest possible respirable dust concentrations.

The following sections of this manual detail those methods by which the above three principles can best be applied.

3.0 MINE WATER SUPPLY SYSTEM

3.1 MINE SUPPLY

Only a few coal mines suffer from a scarcity of main water supply. Water is obtained from a number of sources. These include rivers, creeks, wells, reservoirs, which are fed by streams or rainfall, or city water supplies. This water commonly is pumped into surface storage tanks. Water from the storage tanks or reservoirs is fed into the mine water distribution system and gravity head is relied upon to develop the pressure required for distribution and use. If too great, it is reduced and if insufficient, the pressure must be increased by a booster pump.

The underground water piping system must be sized in accordance with need. The size of the piping should be large enough to provide, as a minimum, a conventional mining section with 15 gallons of water per minute, a continuous mining section with 35 gpm and a longwall section with 50 gpm. The water line ending at the loading head of any section should not be smaller than 2 inches in inside diameter. Flexible hose used in by the loading head should be large enough to provide sufficient water for the equipment to which it is attached. Some of the older continuous mining equipment requires a resizing of water hose to provide the spray nozzles with the proper amount of spray water.

Tables 3-1 and 3-2 can be used to calculate the pressure loss due to friction in both pipes and hoses. Most sprays require a minimum of 100 psi at the spray to be fully effective. The water pressure to each section should be measured and friction loss from that point to the sprays calculated. If the pressure, as measured, less the calculated loss, results in pressures lower than 100 psi, a water booster pump must be installed.

Each nozzle manufacturer has its own recommendations for the water pressure at which a particular nozzle should be operated. These recommendations should be followed for the most effective use of spray nozzles.

When booster pumps are used, a filter or strainer should be employed on the pump intake to insure the removal of solids (such as pipe scale) to prevent erosion and wear of the impeller. The supply of water to the pump must be of sufficient size to insure that the pump does not operate under a dry suction.

Table 3-1

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FRICITION OF WATER IN PIPES

Friction head in feet per hundred feet of pipe; velocity in feet per second; based on Hazen-Williams formula with C = 100 = 17 year pipe

1/2-INCH PIPE			1-INCH PIPE			1 1/2-INCH PIPE			2-INCH PIPE			2 1/2-INCH PIPE			3-INCH PIPE					
Cap. in GPM	Vel. in FPS	Frict. Head Ft.	Cap. in GPM	Vel. in FPS	Frict. Head Ft.	Cap. in GPM	Vel. in FPS	Frict. Head Ft.	Cap. in GPM	Vel. in FPS	Frict. Head Ft.	Cap. in GPM	Vel. in FPS	Frict. Head Ft.	Cap. in GPM	Vel. in FPS	Frict. Head Ft.			
2	1.29	2	4	1.49	2.1	5	1.67	2.84	5	1.79	4	10	1.02	.5	15	1.05	.36			
3	1.80	4	6	2.23	4.6	10	2.11	3.1	10	1.57	1.5	15	1.65	1.1	20	1.31	.61			
4	2.41	7	8	2.93	7.8	15	3.21	6.5	15	2.35	3.1	20	2.01	1.8	30	1.96	1.29			
5	3.01	11	10	3.72	11.7	20	4.29	11.1	20	3.15	5.2	25	2.55	2.7	40	2.61	2.2			
6	3.61	15	15	5.57	25.	25	5.36	16.6	25	3.93	7.8	30	3.06	3.8	50	3.27	3.3			
8	4.81	25	20	7.44	42.	30	6.43	23.5	30	4.72	11.0	35	3.57	5.1	60	3.92	4.6			
10	6.02	38	25	9.30	61.	35	7.51	31.2	35	5.51	14.7	40	4.08	6.6	70	4.53	6.2			
12	7.22	53	30	11.15	89.	40	8.58	40.	40	6.30	18.8	50	5.11	9.9	80	5.23	7.9			
15	9.02	80	35	13.02	110.	50	10.72	60.	50	7.87	25.4	60	6.13	13.9	90	5.98	9.8			
20	12.03	136	40	14.88	152.	60	12.67	85.	60	9.44	39.6	70	7.15	18.1	120	7.31	16.8			
						70	15.01	113.	70	11.02	53.0	80	8.17	23.7	140	9.15	22.3			
												80	9.19	29.4	160	10.46	29.0			
												100	10.21	35.8	180	11.76	35.7			
												120	12.25	50.	200	13.07	43.1			
												140	14.30	67.	220	14.33	52.0			
												240	15.70	61.0	320	14.52	42.3			
												310	15.43	47.9	310	15.43	47.9			
4-INCH PIPE			5-INCH PIPE			6-INCH PIPE			8-INCH PIPE			10-INCH PIPE			12-INCH PIPE			14-INCH PIPE		
Cap. in GPM	Vel. in FPS	Frict. Head Ft.	Cap. in GPM	Vel. in FPS	Frict. Head Ft.	Cap. in GPM	Vel. in FPS	Frict. Head Ft.	Cap. in GPM	Vel. in FPS	Frict. Head Ft.	Cap. in GPM	Vel. in FPS	Frict. Head Ft.	Cap. in GPM	Vel. in FPS	Frict. Head Ft.	Cap. in GPM	Vel. in FPS	Frict. Head Ft.
40	1.02	.22	70	1.14	.21	100	1.12	.17	200	1.27	.2	300	1.23	.1	1000	2.84	.40	1200	2.50	0.27
60	1.53	.47	100	1.63	.41	150	1.70	.31	250	1.59	.3	400	1.61	.19	1200	3.41	.60	1300	2.71	0.32
80	2.04	.8	150	2.45	.81	200	2.27	.59	300	1.91	.4	500	2.05	.27	1400	3.97	.73	1400	2.92	0.26
100	2.55	1.22	200	3.27	1.43	250	2.84	.90	400	2.56	.6	600	2.46	.4	1600	4.54	1.03	1500	3.13	0.42
120	3.06	1.7	250	4.09	2.25	300	3.41	1.4	500	3.19	.8	800	3.28	.7	1800	5.11	1.23	1600	3.34	0.47
140	3.57	2.3	300	4.90	3.14	350	3.97	1.7	600	3.83	1.2	1000	4.10	1.	2000	5.53	1.60	1700	3.54	0.52
160	4.08	2.9	350	5.72	4.19	400	4.54	2.3	700	4.43	1.5	1200	4.92	1.5	2200	6.23	1.80	1800	3.75	0.53
180	4.60	3.61	400	6.54	5.4	450	5.01	2.8	800	5.12	2.1	1400	5.64	1.3	2400	6.72	2.	1900	3.96	0.53
200	5.11	4.4	450	7.35	6.7	500	5.5	3.16	900	5.72	2.5	1600	6.56	2.4	2600	7.38	2.5	2000	4.17	0.70
250	5.37	7.7	500	8.17	8.1	600	6.8	5.0	1000	6.38	2.8	1800	7.38	2.9	2800	7.95	2.7	2200	4.59	0.84
300	7.66	9.3	550	8.99	9.6	700	7.92	6.1	1200	7.66	4.2	2000	8.20	3.8	3000	8.52	3.3	2400	5.00	0.93
350	8.92	14.5	600	9.80	11.3	800	9.03	8.1	1300	8.30	4.7	2200	9.02	4.2	3200	9.08	3.7	2500	5.41	1.17
400	10.21	16.0	650	10.62	13.2	900	10.2	10.9	1400	8.54	5.5	2400	9.71	5.1	3400	9.65	4.1	2800	5.84	1.32
450	11.49	19.8	700	11.44	15.1	1000	11.2	12.9	1500	9.57	6.5	2600	10.66	6.0	3600	10.25	4.5	3000	6.22	1.44
500	12.77	24.0	750	12.26	17.2	1100	12.3	14.6	1600	10.20	7.6	2800	11.48	6.5	3800	10.70	4.9	3200	6.63	1.57
550	14.04	28.7	800	13.07	19.4	1200	13.6	18.1	1800	11.50	9.0	3000	12.30	7.9	4000	11.36	5.6	3500	7.30	1.57
600	15.32	33.7	1000	16.34	29.2	1300	14.7	20.2	2000	12.76	11.5	3200	13.12	8.6	4100	12.50	6.7	4200	8.76	2.77
700	17.87	44.9	1200	19.61	40.9	1400	15.8	22.5	2200	13.95	13.0	3400	13.94	9.7	4800	13.64	7.6	4300	10.21	3.70
						1500	17.0	25.9	2400	15.31	15.1				5200	14.77	8.8	5000	11.70	4.75
															5600	15.91	9.9	6300	13.13	5.30
															6000	17.01	12.0	7000	14.50	7.03
16-INCH PIPE			20-INCH PIPE			24-INCH PIPE			30-INCH PIPE			36-INCH PIPE			42-INCH PIPE					
Cap. in GPM	Vel. in FPS	Frict. Head Ft.	Cap. in GPM	Vel. in FPS	Frict. Head Ft.	Cap. in GPM	Vel. in FPS	Frict. Head Ft.	Cap. in GPM	Vel. in FPS	Frict. Head Ft.	Cap. in GPM	Vel. in FPS	Frict. Head Ft.	Cap. in GPM	Vel. in FPS	Frict. Head Ft.			
1800	2.88	.30	3500	3.58	.31	5000	3.55	.27	8000	3.61	.238	13000	4.10	.21	20000	4.52	.25			
2000	3.19	.39	4000	4.09	.47	6000	4.25	.38	9000	4.03	.278	14000	4.42	.24	22000	5.03	.23			
2400	3.73	.51	4500	4.60	.58	7000	4.95	.50	10000	4.53	.36	15000	4.73	.30	24000	5.54	.32			
2800	4.47	.63	5000	5.12	.67	8000	5.68	.63	11000	4.96	.40	16000	5.20	.35	25000	6.01	.39			
3200	5.11	.87	5500	5.57	.81	9000	6.39	.83	12000	5.00	.47	17000	5.36	.37	28000	6.47	.43			
3600	5.75	1.13	6000	6.14	.93	10000	7.20	1.10	13000	5.91	.54	18000	5.69	.41	30000	6.93	.52			
4000	6.38	1.40	6500	6.65	1.11	11000	7.91	1.19	14000	6.36	.62	19000	5.94	.46	32000	7.39	.56			
4400	7.02	1.68	7000	7.16	1.25	12000	8.51	1.34	15000	6.82	.71	20000	6.30	.54	34000	7.86	.64			
4500	7.57	1.90	7500	7.68	1.46	13000	9.22	1.62	16000	7.23	.83	21000	6.62	.58	36000	8.32	.69			
5200	8.30	2.17	8000	8.19	1.69	14000	9.95	1.81	17000	7.72	.91	22000	6.95	.62	38000	8.79	.78			
5600	8.93	2.42	8500	8.70	1.87	15000	10.64	2.17	18000	8.29	1.01	23000	7.22	.65	40000	9.25	.89			
6000	9.57	2.90	9000	9.20	2.01	16000	11.38	2.47	19000	8.64	1.14	24000	7.56	.71	42000	9.70	.97			
6500	10.37	3.35	9500	9.72	2.30	17000	12.09	2.82	20000	9.03	1.19	25000	7.88	.76	44000	10.30	1.03			
7000	11.17	3.58	10000	10.20	2.52	18000	12.80	2.99	21000	9.55	1.30	26000	8.18	.82	46000	10.65	1.14			
7500	11.96	4.21	10500	10.75	2.61	19000	13.50	3.37	22000	10.00	1.47	28000	8.52	.92	48000	11.11	1.22			
8000	12.76	4.80	11000	11.25	2.95	20000	14.20	3.51	23000	10.43	1.58	30000	9.45	1.12	50000	11.52	1.30			
8500	13.55	5.52	11500	11.76	3.12				24000	10.96	1.75	32000	10.09	1.26	52000	12.05	1.39			
9000	14.35	5.50	12000	12.26	3.38				25000	11.40	1.83	34000	10.72	1.33	54000	12.49	1.50			
9500	15.16	6.21	12500	12.80	3.63				26000	11.81	1.97	36000	11.35	1.42	56000	12.95	1.59			
10000	15.95	6.80	13000	13.30	4.05				27000	12.30	2.21	38000	11.94	1.66	58000	13.4	1.62			
10500	16.75	7.30	14000	14.29	4.40				28000	12.75	2.38	40000	12.60	1.91						

FRICITION EQUIVALENTS OF VALVES AND FITTINGS

Expressed as equivalent number of feet of straight pipe.

Example: The loss of head caused by an 8" gate valve is equivalent to the loss of head that would be caused by 8.10 feet of 8" pipe.

Size of Pipe	1/2"	3/4"	1"	1 1/4"	1 1/2"	2"	2 1/2"	3"	3 1/2"	4"	4 1/2"	5"	6"	7"	8"	10"	12"
Gate Valves	.34	.48	.54	.90	1.09	1.49	1.66	2.48	2.32	3.44	3.95	4.57	5.72	6.90	8.10	10.7	12.5
Globe Valves	2.63	3.80	5.12	7.22	8.72	11.3	14.9	19.7	23.4	27.5	31.6	36.6	45.3	55.2	64.8	85.6	108.
Angle Valves	1.20	1.71	2.30	3.24	3.92	5.36	6.72	8.87	10.53	12.4	14.2	16.5	20.6	24.8	29.2	33.5	48.6
Std. L's, Red. T's	.89	1.27	1.72	2.42	2.92	3.93	5.09	6.66	7.84	9.22	10.6	12.2	15.3	18.5	21.7	28.7	36.2
Side Out. T's	1.79	2.52	3.40	4.80	5.79	7.92	9.93	13.11	15.65	18.3	21.0	24.3	30.5	36.7	43.1	56.9	71.3
Long Rad. L's. Run of Std. T's	.41	.63	.85	1.19	1.43	1.98	2.46	3.25	3.80	5.43	5.20	6.00	7.55	9.10	10.7	14.1	17.3

PRESSURE EQUIVALENTS

HEAD IN FEET TO LBS. PER SQ. INCH					
Head in Feet	Pressure in Lbs./Sq. In.	Head in Feet	Pressure in Lbs./Sq. In.	Head in Feet	Pressure in Lbs./Sq. In.
1	.43	52	22.5	204	88.4
2	.86	54	23.4	208	90.1
3	1.30	56	24.3	212	91.8
4	1.73	58	25.1	216	93.6
5	2.16	60	26.0	220	95.3
6	2.59	62	26.9	224	97.0
7	3.03	64	27.7	228	98.8
8	3.46	66	28.6	232	100.
9	3.89	68	29.5	236	102.
10	4.33	70	30.3	240	104.
11	4.76	72	31.2	244	106.
12	5.20	74	32.1	248	107.
13	5.63	76	32.9	252	109.
14	6.06	78	33.8	256	111.
15	6.49	80	34.7	260	113.
16	6.93	82	35.5	264	114.
17	7.36	84	36.4	268	116.
18	7.79	86	37.3	272	118.
19	8.22	88	38.1	276	120.
20	8.66	90	39.0	280	121.
21	9.09	92	39.9	284	123.
22	9.53	94	40.7	288	125.
23	10.0	96	41.6	292	126.
24	10.4	98	42.5	296	128.
25	10.8	100	43.3	300	130.
26	11.3	104	45.1	310	134.
27	11.7	108	46.8	320	138.
28	12.1	112	48.5	330	143.
29	12.6	116	50.2	340	147.
30	13.0	120	52.0	350	152.
31	13.4	124	53.7	360	156.
32	13.9	128	55.4	370	160.
33	14.3	132	57.2	380	165.
34	14.7	136	58.9	390	169.
35	15.2	140	60.6	400	173.
36	15.6	144	62.4	420	182.
37	16.0	148	64.1	440	191.
38	16.5	152	65.8	460	199.
39	16.9	156	67.6	480	208.
40	17.3	160	69.3	500	217.
41	17.8	164	71.0	520	225.
42	18.2	168	72.8	540	234.
43	18.6	172	74.5	560	242.
44	19.1	176	76.2	580	251.
45	19.5	180	78.0	600	260.
46	19.9	184	79.7	650	282.
47	20.4	188	81.4	700	303.
48	20.8	192	83.2	800	347.
49	21.2	196	84.9	900	390.
50	21.7	200	86.6	1000	433.

LBS. PER SQ. INCH TO HEAD IN FEET					
Pressure in Lbs./Sq. In.	Head in Feet	Pressure in Lbs./Sq. In.	Head in Feet	Pressure in Lbs./Sq. In.	Head in Feet
0.1	.23	41	94.7	91	210
0.2	.46	42	97.0	92	213
0.3	.69	43	99.3	93	215
0.4	.92	44	102.	94	217
0.5	1.16	45	104.	95	219
0.6	1.39	46	106.	96	222
0.7	1.62	47	109.	97	224
0.8	1.85	48	111.	98	226
0.9	2.08	49	113.	99	229
1.	2.31	50	116.	100	231
2.	4.62	51	118.	102	236
3.	6.93	52	120.	104	240
4.	9.23	53	122.	106	245
5.	11.6	54	125.	108	249
6.	13.9	55	127.	110	254
7.	16.2	56	129.	112	259
8.	18.5	57	132.	114	263
9.	20.8	58	134.	116	268
10.	23.1	59	136.	118	273
11.	25.4	60	139.	120	277
12.	27.7	61	141.	122	282
13.	30.0	62	143.	124	286
14.	32.3	63	146.	126	291
15.	34.7	64	148.	128	296
16.	37.0	65	150.	130	300
17.	39.3	66	153.	132	305
18.	41.6	67	155.	134	310
19.	43.9	68	157.	136	314
20.	46.2	69	159.	138	319
21.	48.5	70	162.	140	323
22.	50.8	71	164.	142	328
23.	53.1	72	166.	144	333
24.	55.4	73	169.	146	337
25.	57.8	74	171.	148	342
26.	60.1	75	173.	150	347
27.	62.4	76	176.	155	358
28.	64.8	77	178.	160	370
29.	67.0	78	180.	165	381
30.	69.3	79	183.	170	393
31.	71.6	80	185.	175	404
32.	73.9	81	187.	180	416
33.	76.2	82	190.	185	427
34.	78.5	83	192.	190	439
35.	80.9	84	194.	195	450
36.	83.2	85	196.	200	462
37.	85.5	86	199.	200	508
38.	87.8	87	201.	210	554
39.	90.1	88	203.	260	601
40.	92.4	89	206.	280	647
		90	208.	300	693

PUMP POWER REQUIREMENTS

1 foot vertical head of water = 0.433 lb. pressure per square inch
 1 pound pressure per square inch = 2.31 feet vertical head of water

1 horsepower hour = 0.746 kilowatt hour
 1 kilowatt hour = 1.341 horsepower hour

$$\text{Theoretical horsepower} = \frac{\text{U. S. gal. per minute} \times \text{head in feet}}{3960}$$

$$\text{Brake horsepower} = \frac{\text{U. S. gal. per minute} \times \text{head in feet}}{3960 \times \text{efficiency of pump}}$$

$$\text{Consumption of electrical energy in kilowatt hours per 1000 U. S. gallons of water pumped} = \frac{\text{Head in feet} \times 0.00315}{\text{Pump efficiency} \times \text{motor efficiency}}$$

3.2 WATER TREATMENT

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Spray nozzles perform effectively only when provided with a sufficient volume of water at the proper pressure, free of particles that can cause clogging. Depending upon the nature of the particle contamination, the particles may be removed by an elaborate settling pond arrangement followed by filtration or simply by filtration. Line filters, to do this, should be self-cleaning, and preferably be an integral part of the mining machine's water system. The machine operator should be responsible for keeping the filter clean. Continuous mining machines are factory equipped with pumps to provide needed pressure as well as water filters. The need for their constant effective use cannot be stressed too highly.

Approximately 30% of mine operators who were surveyed by the authors were using wetting agents on a regular basis. Most companies have tried wetting agents with varying degrees of success. Results of testing, on a relatively uncontrolled basis, have indicated that the more friable coals respond more effectively to wetting agents than others. Experiments run in the Pittsburgh and Pocahontas seams bear this out. The effectiveness in the Pittsburgh seams were negligible, whereas properly applied agents reduced respirable dust in the Pocahontas seams by about 50% as measured gravimetrically.

Wetting agents' compositions vary widely and each must be tested for effectiveness in the specific coal seam and method of mining. Agents must be metered into the water system to insure a homogeneous mixture. Haphazard addition of wetting agents is not effective. Such methods as injection through a metering valve, batch drums or manual addition will only result in alternate heavy and light dilutions. The correct method for injecting additives or wetting agents is through a proportioning pump which will result in an even mixture. This type of pump is readily available and is in general use in the chemical, processing and steel industries. The next six pages provide a listing of manufacturers of wetting agents. Although the list is lengthy, there may be additional manufacturers whose names were inadvertently omitted.

Most wetting agents are marketed by manufacturer's representatives. These people should be contacted for their recommendations as to the most effective product for the requirements of the mine in question. They should be queried as to previous results with the type of coal being mined.

Maintenance of all of the equipment in the water treatment system cannot be too highly stressed. The finest water supply system will not function effectively when clogged.

WETTING AGENTS

California

Dampsure Company
P. O. Drawer 476
Los Gatos, California

Fire-X Corporation
10859 Drury Lane
Lynwood, California

Connecticut

ICI America Inc.
151 South Street
Stamford, Connecticut

Delaware

Atlas Chemical Industries Inc.
New Murphy Road
Wilmington, Delaware

DuPont de Nemours & Co., Inc.
Wilmington, Delaware

Hercules Incorporated
917 King Street
Wilmington, Delaware

Georgia

Cities Services Company
Industrial Chemicals Division
P. O. Box 50360
Atlanta, Georgia

Seydel-Woolley & Company
762 Marietta Boulevard
Atlanta, Georgia

Illinois

London Chemical Company Inc.
240 Foster Avenue
Bensenville, Illinois

Illinois

Central Compounding Company
1718 N. Damen Avenue
Chicago, Illinois

Kraft Chemical Company
917 W. 18th Street
Chicago, Illinois

Maher Color & Chemical Company
6502 S. Harlem Avenue
Chicago, Illinois

Merix Chemical Company
Dept TR
2234 E. 75th Street
Chicago, Illinois

Mertz L. Carlton Company
1638 S. Normal Avenue
Chicago, Illinois

Organic Chemicals Division
of the Richardson Company
3401 W. Touhy Avenue
Chicago, Illinois

Trask, Arthur C. Company
6502 S. Harlem Avenue
Chicago, Illinois

Blockson Chemical Company
Div. of Olin Mathieson
Chemical Corporation
1945 Patterson Road
Joliet, Illinois

Stepan Chemical Company
Northfield, Illinois

Swift Chemical Company
Div. of Swift & Company
Chemicals for Industry
1211 W. 22nd Street
Oak Brook, Illinois

Nalco Chemical Company
180 N. Michigan Avenue
Chicago, Illinois

Maine

Bliss-Portland Company
A Gulf+Western Precision
Engineering Company
98 Second Street
South Portland, Maine

Maryland

Alcolac Chemical Corporation
3440 Fairfield Road
Baltimore, Maryland

Massachusetts

Dewey & Almy Chemical Div.
62 Whittmore Avenue
Boston, Massachusetts

Bliss-Gamewell Division
1236 Chestnut Street
Newton Upper Falls, Massachusetts

Angler Chemical Company
100 Messenger
Plainville, Massachusetts

Michigan

Ajem Laboratories, Inc.
38899 Schoolcraft Road
Livonia, Michigan

Eaton Chemical Corporation
13395 Huron River Drive
Romulus, Michigan

Udylite Corporation
21441 Hoover Road
Warren, Michigan

Wyandotte Chemicals Corporation
Industrial Chemicals Group
Alkali Square
Wyandotte, Michigan

Minnesota

Rayette Inc.
Chemical Division
269 East Fifth
St. Paul, Minnesota

Missouri

Jesco Lubricants Company
1437 Gentry
North Kansas City, Missouri

Monsanto Inorganic Chemicals
800 N. Lindberg Road
St. Louis, Missouri

Peck's Products Company
610 E. Clarence Avenue
St. Louis, Missouri

Tretolite Division
Petrolite Corporation
369 Marshall Avenue
St. Louis, Missouri

Nevada

Hardesty Chemical Company
Henderson, Nevada

New Jersey

Baker Castor Oil Company
40 Avenue A
Bayonne, New Jersey

Chemical Coating Materials Company
30 Little
Belleville, New Jersey

American Cyanamid Company
Organic Chemicals Div.
Bound Brook, New Jersey

Clackson Laboratories Inc.
1450 Ferry Avenue
Camden, New Jersey

New Jersey

Carlstadt Chemical Company
Carlstadt, New Jersey

Almo Laboratories Company, Inc.
49-T Village Park Road
Cedar Grove, New Jersey

Aquadyne Corporation
89-T Terminal Avenue
Clark, New Jersey

Finetex Inc.
416 Falmouth Avenue
East Paterson, New Jersey

Royce Chemical Company
17 Carlton Avenue
East Rutherford, New Jersey

Apex Chemical Company, Inc.
202 S 1st
Elizabethport, New Jersey

Emkay Chemical Company
319 Second
Elizabethport, New Jersey

Calfonex, Inc.
168 Coolidge Avenue
Englewood, New Jersey

Ciba Chemical & Dye Company
Fair Lawn, New Jersey

Sandoz, Inc.
Hanover, New Jersey

Miranol Chemical Company, Inc.
279 Coit
Irvington, New Jersey

Fabric Chemicals Company
61 Cornelison Avenue
Jersey City, New Jersey

Onyx Chemical Corporation
190-T Warren
Jersey City, New Jersey

New Jersey

Titan Chemical Products, Inc.
Mill Road & Wayne
Jersey City, New Jersey

Wilson, A. L. Chemical Company
1050 Harrison Avenue
Kearny, New Jersey

Fine Organics Inc.
Department T
205 Main
Lodi, New Jersey

Stepan Chemical Company
Maywood Division
100 West Hunter Avenue
Maywood, New Jersey

Allied Chemical Corporation
Specialty Chemicals Div.
Box 70
Morristown, New Jersey

Arkansas Company, Inc.
185 Foundry
Newark, New Jersey

Atlas Refinery, Inc.
142 Lockwood
Newark, New Jersey

Colloids, Inc.
394-T Frelinghuysen Avenue
Newark, New Jersey

Nopco Chemical Company
Div. Diamond Shamrock Chemical Company
60 Park Place
Newark, New Jersey

Quimby & Company
72 Chapel
Newark, New Jersey

Troy Chemical Corporation
338 Wilson Avenue
Newark, New Jersey

New Jersey

Advance Division
500 Jersey Avenue
New Brunswick, New Jersey

Rhodia, Inc.
Chipman Division
P. O. Box 2009
New Brunswick, New Jersey

Tect, Inc.
254 Livingston
Northvale, New Jersey

Mona Industries, Inc.
65 E. 23rd Street
Paterson, New Jersey

Organic Chemicals Division of
The Richardson Company
137 New
Paterson, New Jersey

Tenneco Chemicals, Inc.
Intermediates Division
P. O. Box 2
Piscataway, New Jersey

American Cyanamid Company
Agricultural Division
Princeton, New Jersey

International Products Corporation
P. O. Box 118
Trenton, New Jersey

Verona Dyestuffs Division
P. O. Box 385
Union, New Jersey

American Cyanamid Company
Industrial Chemicals Division
Wayne, New Jersey

New York

Surpass Chemical Company, Inc.
1256 Broadway
Albany, New York

New York

Geigy Chemical Corporation
Ardsley, New York

Smith Chemical & Color Co., Inc.
Foot of Commerce
Brooklyn, New York

Textile Adjuncts Corporation
4905 Farragut Road
Brooklyn, New York

Burrell L. O. Company, Inc.
Kirkover Street Ext. & PRR
Buffalo, New York

De Paul Chemical Company, Inc.
44-27 Purvis
Long Island City, New York

Advance Solvents & Chemical Corpora
28th and 5th Avenue
New York City, New York

Alconox, Inc.
217 Park Avenue, S.
New York City, New York

GAF Corporation
Dyestuff & Chemical Division
140 W. 51st
New York City, New York

M. Michel & Company
90 Broad
New York, New York

Olin Corporation
Chemical Division
745 Fifth Avenue
New York City, New York

Pfizer Chas. & Company, Inc.
235 E. 42nd
New York City, New York

Philipp Brothers Chemical, Inc.
10-12 Columbus Circle
New York City, New York

New York

Stauffer Chemical Company
Specialty Chemical Div.
299 Park Avenue
New York City, New York

Union Carbide Corporation
Chemicals & Plastics
270 Park Avenue
New York City, New York

Valchem Chemical Division
1407 Broadway
New York City, New York

Vanderbilt R. T. Company, Inc.
230 Park Avenue
New York City, New York

Witco Chemical Corporation
277 Park Avenue
New York City, New York

Lockery Company
Lubricants Division
Southampton, New York

Shanco Plastics & Chemicals, Inc.
Fillmore & Wales
Tonawanda, New York

North Carolina

Marlow-Van Loan Corporation
High Point, North Carolina

Ohio

Monsanto Chemical Company
Rubber Service Department
Akron, Ohio

Signal Division
Bedford, Ohio

Carlisle Chemical Works, Inc.
West Street
Cincinnati, Ohio

Ohio

DuBois Chemicals Division of
W. R. Grace & Company
1101 DuBois Tower
Cincinnati, Ohio

Emery Industries, Inc.
3500 Carew Tower
Cincinnati, Ohio

Zimmerman C. L. Company
N-203 Cincinnati Union Terminal
Cincinnati, Ohio

Mooney Chemicals, Inc.
2269 Scranton Road
Cleveland, Ohio

Ashland Chemical Company
Div. of Ashland Oil, Inc.
8 E Long
Columbus, Ohio

Pennsylvania

Beaver Alkali Products
P. O. Box 4
Beaver, Pennsylvania

Alco Chemical Corporation
Trenton Avenue & William
Philadelphia, Pennsylvania

Arco Chemical Company
260 S. Broad
Philadelphia, Pennsylvania

Houghton E. F. & Company
303 W. Lehigh Avenue
Dept. 154
Philadelphia, Pennsylvania

Johnson-March Corporation
3016 Market
Philadelphia, Pennsylvania

Laurel Products Corporation
2600 E. Tioga
Philadelphia, Pennsylvania

Pennsylvania

Leatex Chemical Company
2722 N. Hancock
Philadelphia, Pennsylvania

Panacalite Pacific, Inc.
845 E. 60th
Philadelphia, Pennsylvania

Penn Crete Products, Inc.
2745 N. Amber
Philadelphia, Pennsylvania

Rohm and Haas Company
Independence Mall West
Philadelphia, Pennsylvania

Scholler Brothers, Inc.
Collins & Westmoreland
Philadelphia, Pennsylvania

Service Industries
2101 E. Somerset
Philadelphia, Pennsylvania

Rhode Island

Wayland Chemical Division
P. O. Box "0"
Lincoln, Rhode Island

Synthron, Inc.
171 Pawtucket Avenue
Pawtucket, Rhode Island

Bercen Chemical Company, Inc.
285-T Valley
Providence, Rhode Island

Eastern Color & Chemical Company
35 Livingston
Providence, Rhode Island

Saluol Chemical Company
Green Hill & Market
West Warwick, Rhode Island

Tennessee

GAF Corporation Textile Chemical Div
1228 Chestnut
Chattanooga, Tennessee

Mac Chemical Company
Knoxville, Tennessee

Davis-Weil Manufacturing Company
219 Scott
Memphis, Tennessee

Kano Laboratories, Inc.
1079 Thompson Lane
Nashville, Tennessee

Texas

Petrochemicals Company, Inc.
P. O. Box 2199
Fort Worth, Texas

Aquaness Chemical Company
2434 Holmes Road
Houston, Texas

Retzloff Chemical Company
P. O. Box 45296-TR
Houston, Texas

Wisconsin

Klenzade Products
Division X-1
Beloit, Wisconsin

Essential Chemicals Corporation
28391 Philmont Road
Merton, Wisconsin

3.3 SPRAY NOZZLES

Water sprays are most effectively utilized to supply a fine, heavy and directed stream of water to points of dust generation. Tests have proven that a solid stream of water is not nearly as effective or as efficient as an atomized spray. The small droplets of water formed by sprays tend to encapsulate the dust as contact is made. The wetted dust will then fall or adhere to larger particles of coal. Since spraying is a more efficient method than solid streams of water, it follows that less water will be required to accomplish the objective.

A plugged or partially plugged water spray is useless. The proper maintenance of the sprays is vital. Without sprays operable, the water supply system to the section is meaningless. Sprays must be maintained and checked constantly. Pipe scale or particles in the water can be prevented from clogging the sprays by proper filtration and maintenance of the filter. Plugging caused by external dust and pieces of coal can be eliminated by turning sprays on prior to sumping in. A clogged spray nozzle should be removed, cleaned and replaced. Water pressure should be maintained at 100 to 300 psi for effective spraying.

There are four types of nozzles in general use. Following is a description of each type and its most preferred use within the mine.

3.3.1 FULL CONE NOZZLE

The full-cone nozzle probably has the widest application in mines being used for dust suppression on all types of mining equipment. It provides a uniform distribution of water droplets over a circular area. It forms a spray of relatively large droplets. The size of the droplets is dependent upon its configuration and water pressure. Distance and high speed of travel of the droplets characterize this nozzle.

Used for: Face sprays
 Loading machines
 Transfer points

3.3.2 HOLLOW CONE NOZZLE

The hollow-cone nozzle forms a wide angle circular spray which is hollow in the center. Compared to droplet size of the solid cone, its droplets are much smaller, but again, droplet size is dependent upon configuration and water pressure. The hollow center and wide angle of its spray pattern identifies this nozzle and are the reasons for its use in water curtains and at places where the dust is widely dispersed at generation points.

Used for: Belt haulage
 Transfer points

3.3.3 FLAT SPRAY NOZZLE

The flat spray nozzle forms a narrow rectangular spray. A flat spray can be designed to form most any spray pattern that is desired. This type of spray nozzle results when a water pipe is flattened at the end. Droplets formed, if at all, are very coarse, otherwise the spray is simply a relatively thick sheet of water. The spray water is delivered at a wide angle with considerable force and the nozzle has been found useful for quickly spraying the tops of moving coal cars and, placed on the sides of auger-type mines, for spraying the height of the coal seam ahead of the augers.

Used for: Spraying haulage cars
 Side sprays on continuous miners

3.3.4 TWO-FLUID NOZZLE

The two-fluid nozzle (air and water blast) forms a fine mist by using compressed air to atomize the water. A two-fluid nozzle is used routinely in some metal mines to allay the dust, reduce the fumes, and dampen the broken material resulting from blasting. The water blast is turned on during the blast and allowed to remain active for a short period of time following the blast. The same method can be used in shot-firing. A spray manifold, directed at the face with sufficient nozzles to blanket the blast area, with the finely atomized spray pattern, can be activated just prior to shooting and turned off within 20 to 30 minutes afterwards. This system will allay the fine dust and fume which is generated.

4.0 MINE VENTILATION SYSTEM

4.0 MINE VENTILATION SYSTEM

The layout of the main mine ventilation system is not within the scope of this manual. It is assumed that air, as needed, for dust control, is available for adequately ventilating a mine section and all of its working faces. Two primary systems are used for coursing air through a mine section, namely, a single split system, as shown in Figure 4-1, and a double-split system as shown in Figure 4-2.

Either ventilation system allows air to be coursed to or from the working faces to obtain the results desired as discussed in the subheadings of face ventilation found under the main headings of mining methods. The double split system is the more complicated and dependent upon proper layout of the main system. It has many operating advantages, is proven to be the most convenient, and is to be preferred when conditions permit its use.

Each mining system has its own ventilation procedure problems with no common ground, except that air from one mining operation, should not be coursed over another mining operation if at all possible. This will hold true until such time as central systems can be made 100 percent efficient. The intent of this cardinal rule cannot be followed in the case of conventional mining where the air becomes dustier as it moves from one face to the next. The time taken for the air to pass through all of the working faces in a section is too short to permit the air to be unloaded by natural forces. This points out the need for maximum suppression of dust from each of the conventional mining machines.

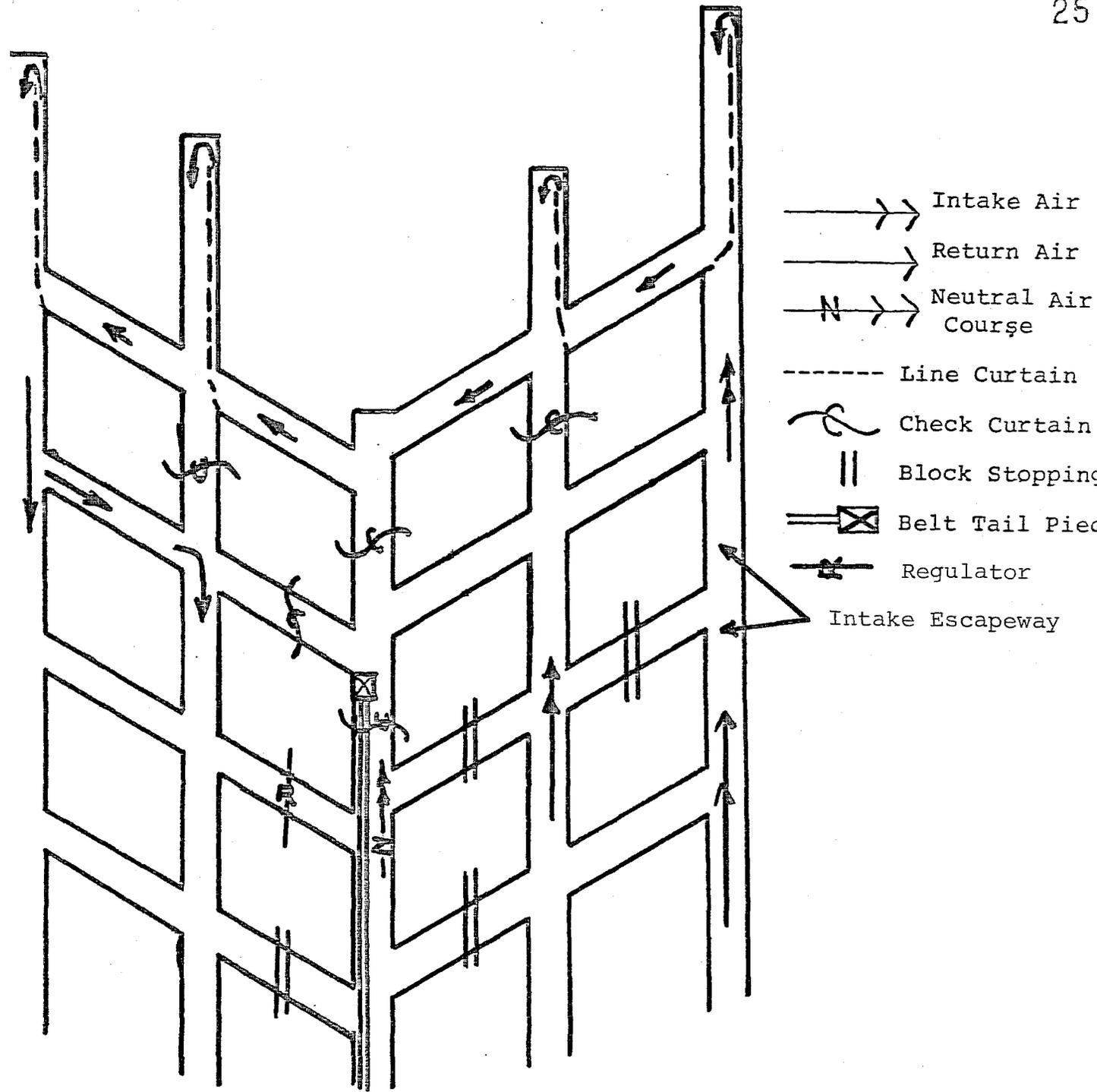


Figure 4-1 Single Split Ventilation System for 5 Entry Panel Development

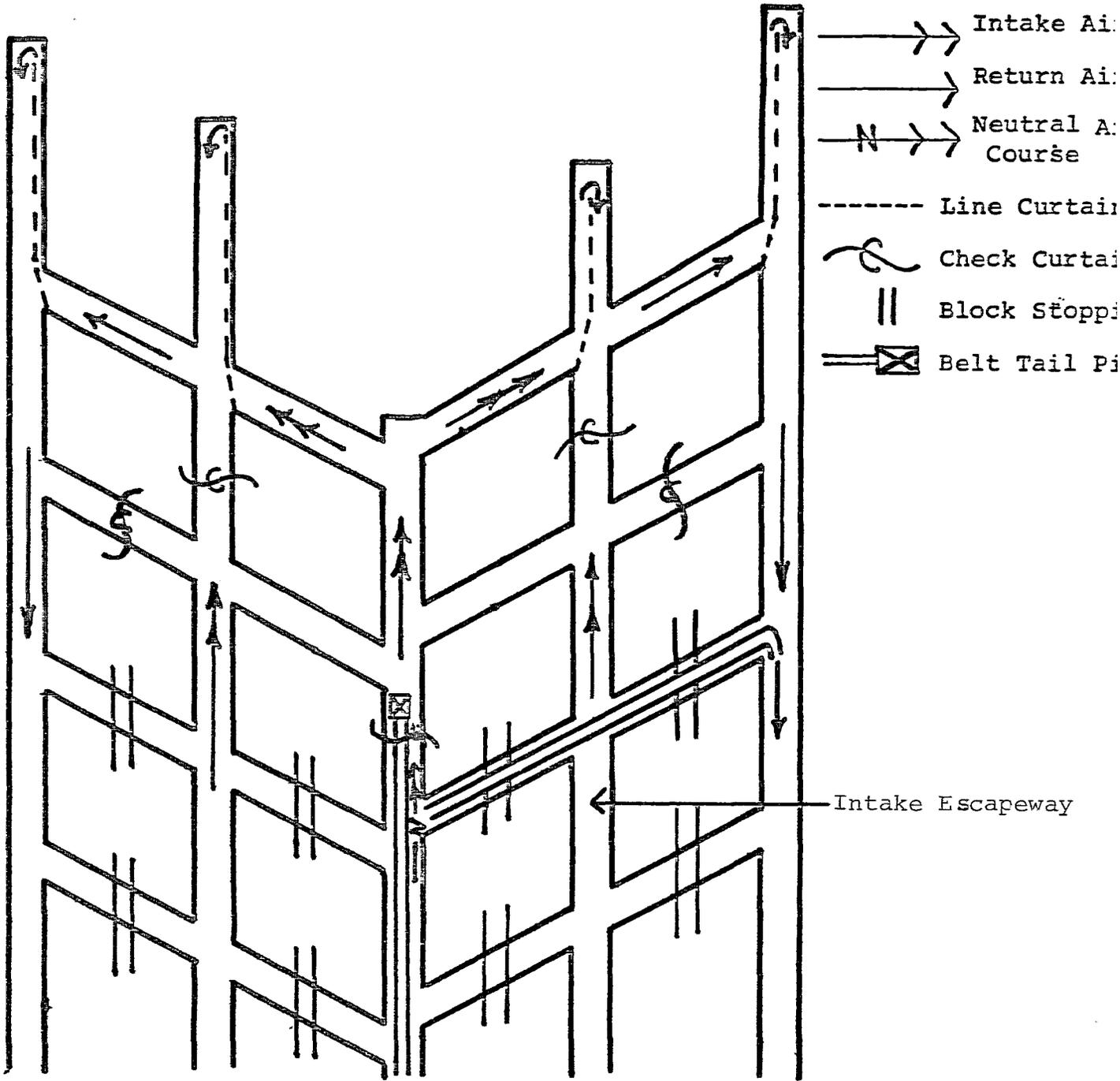


Figure 4-2 Double Split Ventilation System for 5 Entry Panel Development

4.1 EXHAUST TUBING

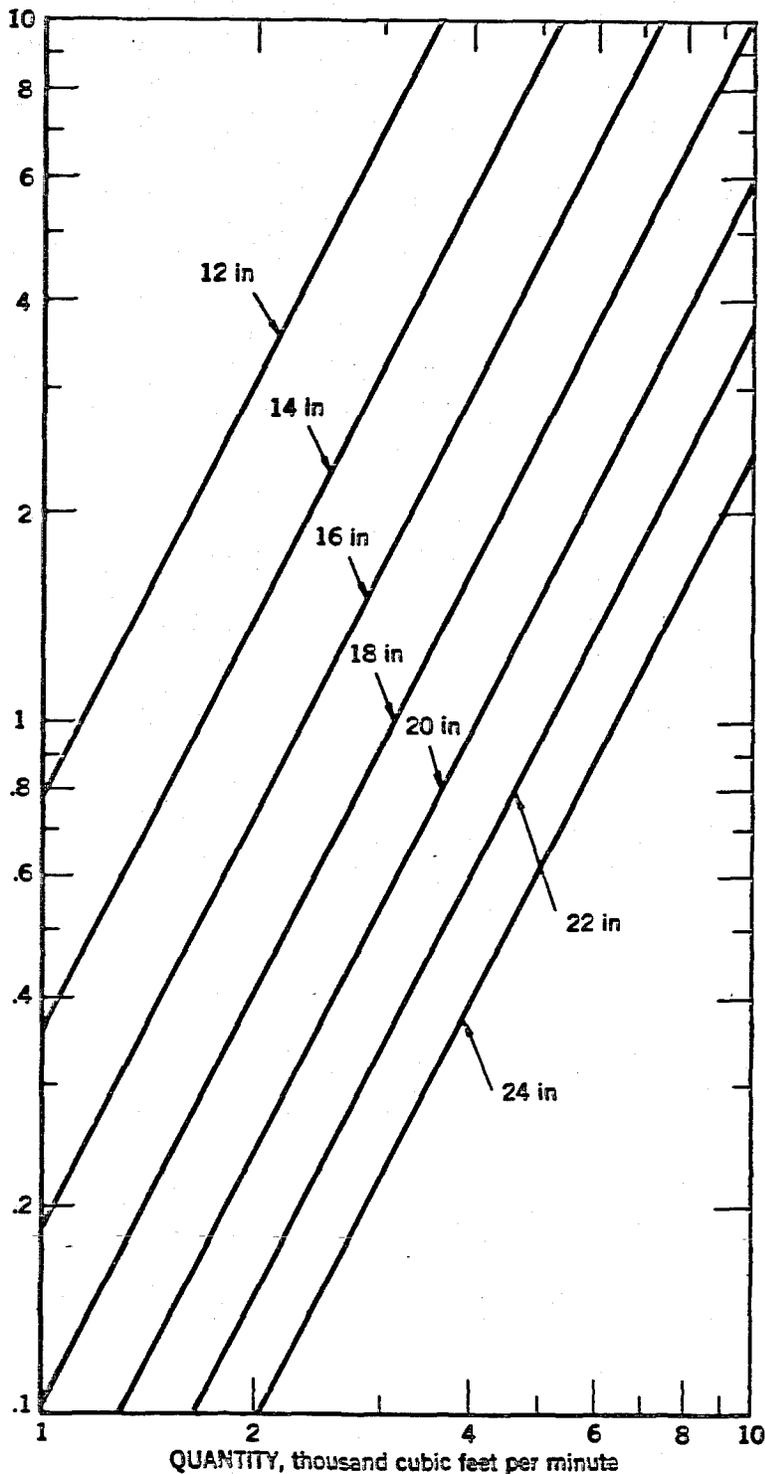
Exhaust tubing is utilized in many operations, in conjunction with an auxiliary exhausting fan, to conduct air out of the working place. It is particularly advantageous in areas where certain types of continuous miners are employed and where line curtain cannot be kept close enough to the face. Use of exhaust tubing and auxiliary fans affords a positive exhaust ventilation system by forcing intake air across the face and out through the tubing and fan to the return air course. Exhaust tubing is also used to discharge air to return courses from exhaust fans and scrubbers which are mounted on continuous mining equipment. Several of these systems are described in Section 5.

Care must be taken to use only wire reinforced exhaust tubing when air is being drawn through the tubing by an auxiliary fan to prevent collapse. If the tubing is used as an exhaust duct from a fan or scrubber mounted on a continuous miner, it need not be reinforced since air is being blown through under pressure.

Tubing comes in diameters from 12" to 24" and as all types of ducting, it has a resistance to flow (pressure drop). Therefore, when tubing is used, its resistance must be calculated to insure that the fan which is employed has sufficient pressure available to overcome this resistance and move the air volume at the velocity required. Each manufacture publishes pressure drop tables for the tubing they furnish. A typical resistance chart is shown in Table 4-1.

When tubing is selected for use it must meet the permissible requirements of the U. S. Bureau of Mines. This requirement is satisfied by ASTM E-162 with a flame spread of less than 25.

Resistance Chart



The adjacent chart shows some of the characteristics of MineDuct Exhaust Ventilation Tubing. This friction chart shows resistance to air in inches water-gage per 100 feet of straight tube, when hung so as to be stretched tight.

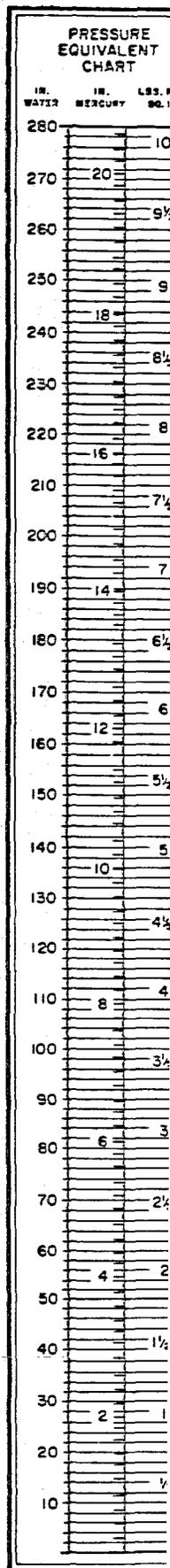
Example:

What is the resistance in 50 feet of 18" MineDuct Exhaust Tubing handling 5000 CFM air?

On the bottom of the chart find 5000 CFM. Follow it up until it intersects the 18" duct diameter line, then read to the left to obtain resistance in 100 feet. In this case about 2.6 inches water gage for 100 feet, or 1.3 per 50 feet.

Pressure Equivalents

- 1 lb. per square inch = 27.7 inches water gage
- 1 inch mercury = 13.6 inches water gage
- 1 oz. per square inch = 1.7 inches water gage



5.0 ENGINEERING METHODS USED TO CONTROL
RESPIRABLE COAL DUST

5.1 CONVENTIONAL MINING

5.1.1 CUTTING MACHINES

Introduction

Cutting machines are used in conventional mining to either undercut, topcut, or shear the coal face prior to drilling and shotfiring. These machines are in general use throughout the bituminous coal industry. Approximately 45% of the underground coal is mined conventionally today. If basic ventilation practices and proper application of water sprays are employed, coal can be undercut without creating high respirable dust concentrations.

Face Ventilation

An exhausting face ventilation system has proven to be most desirable. With line curtains properly maintained and air velocities equal to or exceeding the requirements for methane control, high dust exposures are not encountered. The volume of air for methane control required by law to reach each working face is 3,000 cfm or greater. The period of highest dust generation occurs during the sumping-in portion of the cutting cycle. A standard method of exhausting ventilation is shown in Figure 5-1. High dust exposure problems have been encountered with cutting machines of the top cutting and shearing type, particularly on retreat mining. Top cutting and shearing should be avoided if at all possible. The authors' experience with reducing dust levels from a top cutting machine on retreat, has resulted in the opinion that auxiliary exhausting ventilation is the best means to meet compliance levels. All types and configurations of water sprays were tried to no avail. Exposures remained in the 3.5 to 4.5 mg/m³ range. It was not until auxiliary exhaust tubing was installed and used in conjunction with an auxiliary fan, that exposure levels were reduced to the 2.0 mg/m³ range.

Water Sprays

Some manufacturers of cutting machines and mine operators have for many years supplied water through the cutter bar in addition to mounting spray nozzles on the cutter bar hanger. To wet the cutting chain, a common practice is to supply water through a 1/2" diameter pipe to a 3/8" opening at the end of the bar. The full-cone type nozzles which are mounted on the cutter bar hanger direct water to the ingoing and outgoing bits. Figure 5-2 illustrates a standard method of spray location.

Dust Control Results

Operators using proper ventilation procedures with correct application of water can realize respirable dust concentrations below 2 mg/m³. Of paramount importance is proper maintenance and control of the line curtain and spray nozzles. Line curtains must be kept tight and advanced. Nozzles must be periodically cleaned and it is mandatory that practices set forth in Sections 3 and 4 of this manual be followed.

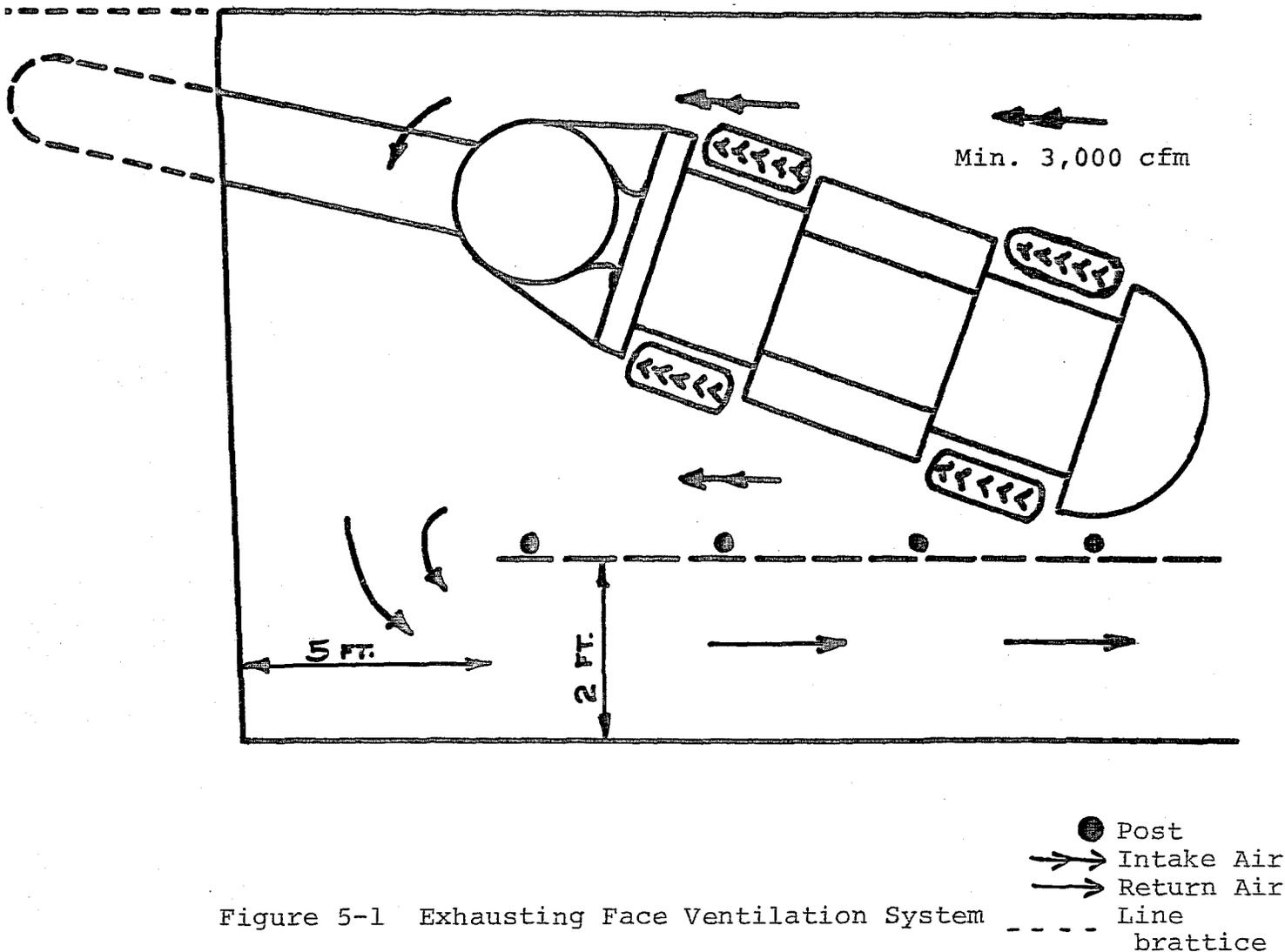
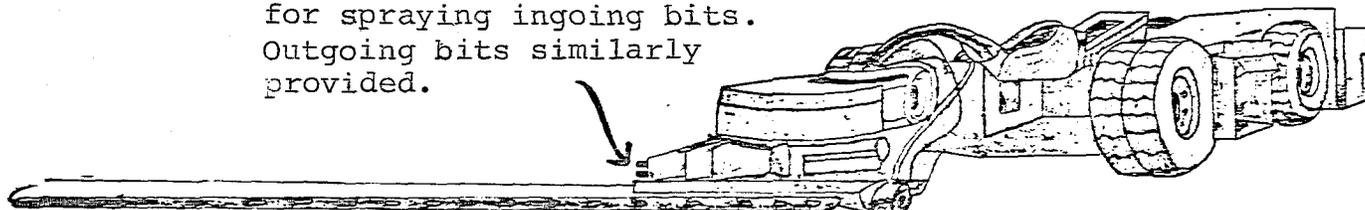


Figure 5-1 Exhausting Face Ventilation System

1 or 2 solid-cone nozzles for spraying ingoing bits. Outgoing bits similarly provided.



1/2" I.D. water line through cutter bar with 3/8" hole in end.

Figure 5-2 Cutting Machine Water Outlet Locations

5.1.2 LOADING MACHINES

In conventional mining the loading machine is necessarily a specialized piece of equipment. Its only function is to load coal onto a means of conveyance after it has been undercut, drilled and broken by blasting. In comparative terms, loading machines do not generate large amounts of dust. Respirable dust results from the loading, conveying and dumping processes. The coal should be wetted well before loading begins. If this is done the coal needs further wetting only during the process of loading, to adequately suppress the dust.

Face Ventilation

Exhausting the air from the face is preferable, but either type of face ventilation can be used. Need for more than 3,000 cfm of air to the face, except for control of methane, indicates a need for improving dust suppression practice. Ventilation practices used for the cutting machines as described in Section 5.1.1 will perform adequately for the loading machines. Figure 5.3 depicts good ventilation practices.

Water Sprays

Spray nozzles of either the full-cone (preferred) or hollow-cone type should be installed and directed as shown in Figure 5-4. The spray patterns should be adjusted so as to wet the coal as it is gathered by the arms and also as it moved onto the conveyor. Each nozzle should deliver a minimum of 0.5 to 0.6 gpm of water forcibly.

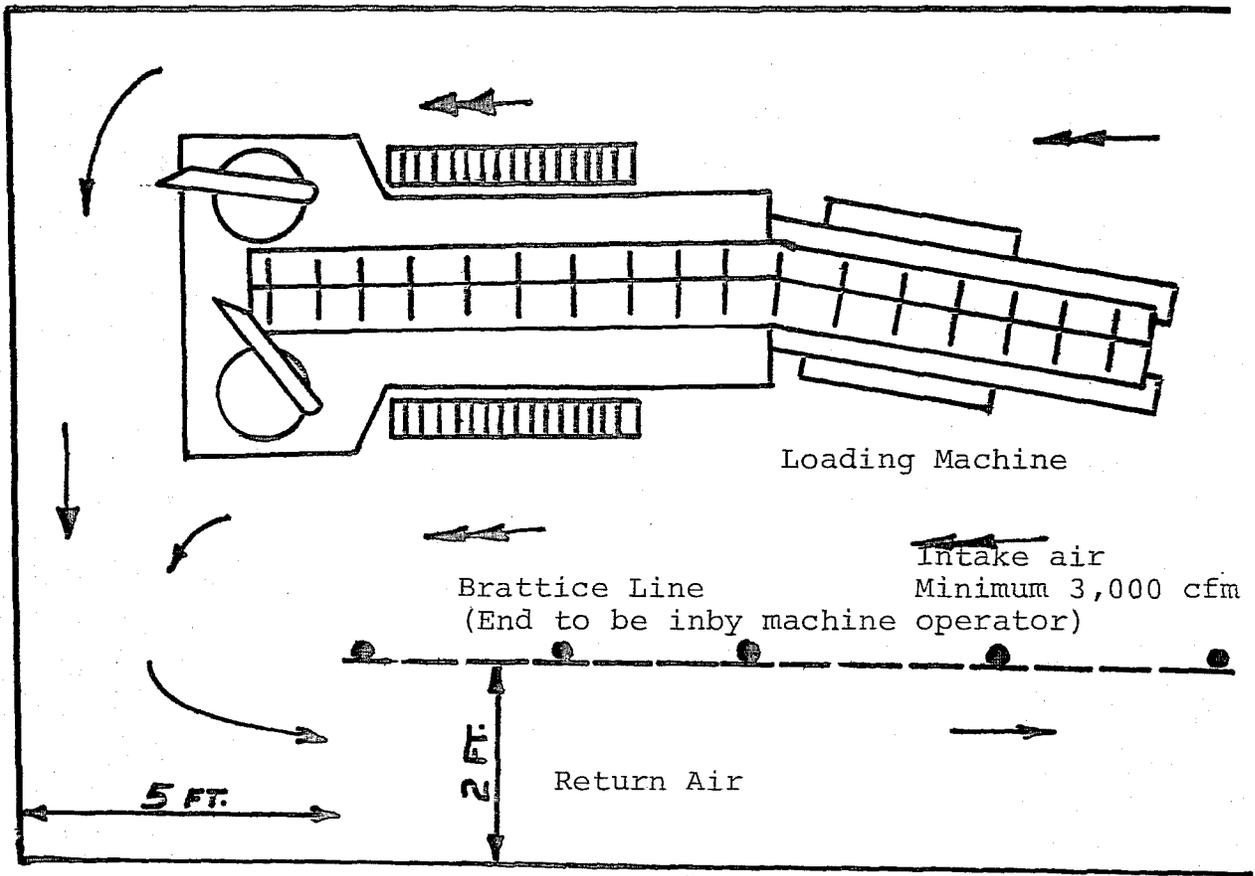


Figure 5-3 Exhausting Face Ventilation System for Loading Machine

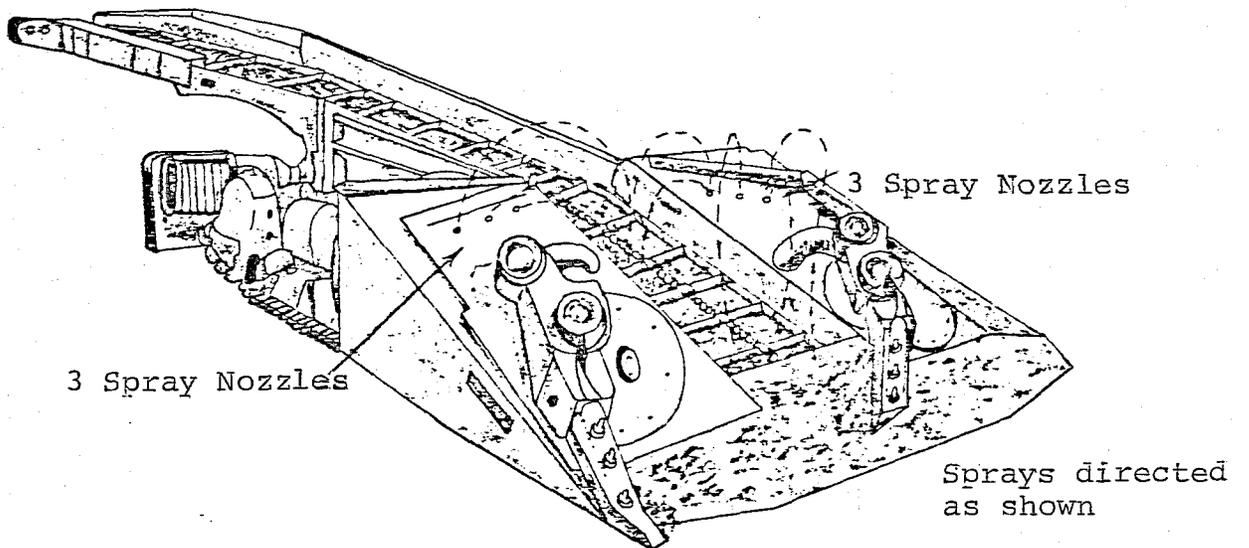


Figure 5-4 Spray Location on Loading Machine

5.1.3 COAL DRILLS

Introducing water through a hollow auger for drilling blast holes successfully controls the dust from coal drilling. Water swivels and other requirements for adaption of this method to mounted or hand held coal drills are readily available, if not an integral part of the drilling machine. The coal cuttings, if wetted sufficiently, drop to the floor with little dispersion of dust. Use of water sprayed at the collar of the hole is a futile attempt to prevent dispersion of drill dust, as many investigators have proven for themselves. The application of water through the drill shaft and bit wets the dust in a confined area at the point of dust generation. This insures efficient wetting of all dust particles.

5.1.4 COAL BLASTING

Off-shift blasting is commonly practiced in metal mines. This reduces the exposure to blasting dust and fumes to a minimum but the conventional mining cycle does not permit its use. In this operation, exposure effects can be somewhat reduced by (1) ventilating the section with a double-split system and carefully cycling the various operations (2) using a compressed gas system for blasting, (3) using water stemming, and (4) infusing the coal bed with water or water with a wetting agent added. Reduction of the dust concentration by passing the air through a spray or curtain of water is questionable, and, at best, very limited and inconvenient.

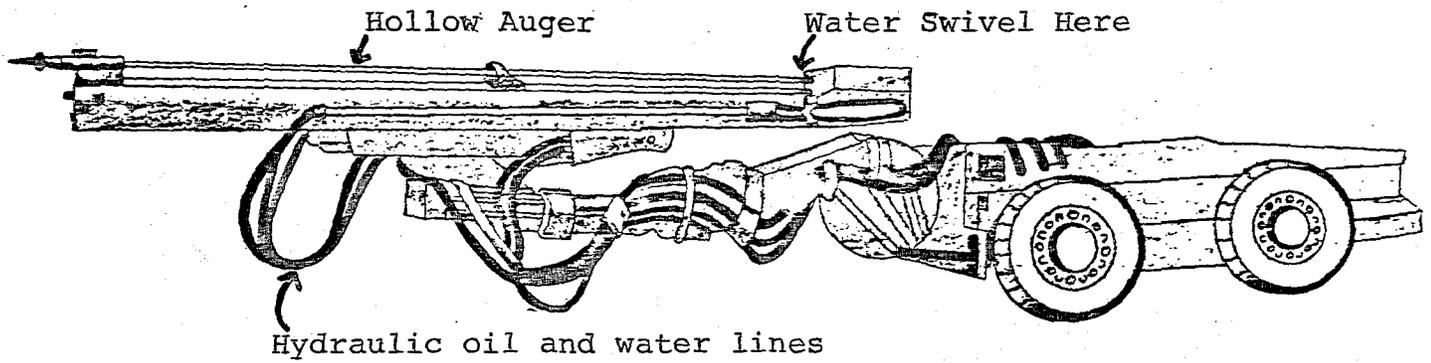


Figure 5-5 Coal Drill Fitted For Wet Drilling

5.2 CONTINUOUS MINERS

5.2.1 BORING MINERS

5.2.1.1 BORERS

Introduction

The borer is a full face machine and in normal applications it advances headings a full cross cut distance (80' -- 90') in one cycle. The arched roof cut by a Twin Borer (Figure 5-6) is considered self supporting during the mining cycle. One or two rows of roof bolts are usually installed after the miner moves out of a place. The miner normally discharges coal onto the mine floor and is followed by a "pick up" loading machine which loads the mined coal into shuttle cars.

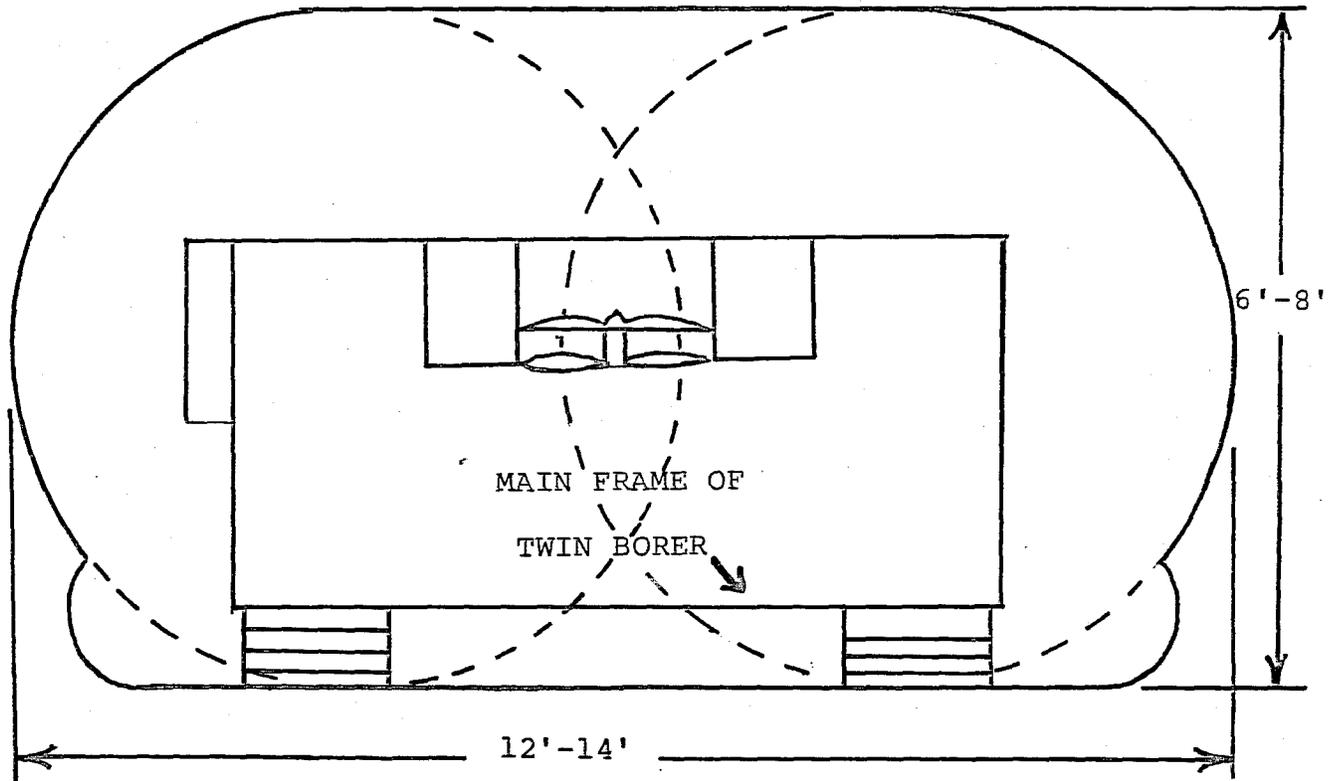


Figure 5-6 - Typical face pattern cut by twin borer

Face Ventilation

Many of the boring machines are operating in the Pittsburgh seam where large quantities of methane are being liberated. Over the years it was felt that a blowing ventilation system was necessary to provide positive control of the gas at the face. In 1969 and 1970 operators using a blowing system discovered that they were unable to comply with the respirable dust standard. Attempts at improving the efficiency of water spray systems failed to reduce dust concentrations to compliance levels. High risk samples averaged over 4.0 mg/m^3 in spite of the most diligent efforts. Most operators have converted to exhausting face ventilation systems and now can comply with the dust and methane standards.

Blowing Ventilation

Following is a review of blowing face ventilation, using line curtain to direct air to the face, as practiced prior to 1970. Nylon reinforced plastic material was preferred and was hung as shown in Figures 5-7. Due to the configuration of the entry and the space requirements of the borer, a recommended way to install line curtains is as follows: Curtains are supported by spads driven into the roof and rib and take the shape of a tube in the curvature of the arch cut by the miner as shown in a section view on Figure 5-7. Figure 5-8 shows the line curtain transition at an intersection, where it extends from the floor to the roof. Here it is supported by any convenient method such as posts or pogo sticks. An auxiliary blowing fan is the most practical means of providing blowing face ventilation.

Exhausting Ventilation

Satisfactory control of dust has been realized only by using an exhausting fan ventilation system (See Figure 5-9). Line curtains cannot be used for directing air from the face as the higher pressure of the intake air collapses the line curtain when hung in the only manner possible as previously described. Wire reinforced or fibre glass tubing must be used when air is exhausted from the face by an exhaust fan. Collapsible tubing may be used when a blowing fan mounted on the boring machine exhausts the air from the face. Tubing size limitations, and therefore high resistance to airflow, requires that some type of fan be used for exhausting the needed volume of face air. When an efficient water spray system and an auxiliary ventilation system capable of exhausting 6,000 cfm of air from the face under the most adverse conditions are used satisfactory control of dust should result. The use of a diffuser fan will further aid in keeping the operator out of a high dust condition as shown on Figure 5-11.

Water Sprays

The boring machines are equipped with 12 to 20 spray nozzles of the solid or hollow cone types. Wide angle spray nozzles are preferred for covering the large cutting area of the machine. Control of dust from the trim chain or corn cob trimmers requires particular attention. Originally these machines were equipped with hydraulically driven water pumps having insufficient capacity. Twelve to 19 gpm of water are required and are being supplied by water systems of

ample capacity and pressure or by replacement pumps of adequate size. Water pressures varying from 100 to 300 psi are being used and satisfactory results are obtained when an adequate volume of water is supplied to the spray nozzles.

Dust Control Results

The use and proper maintenance of water and exhausting face ventilation systems has enabled operators of borers to comply with respirable dust standards. In some cases, high risk samples average under 2.0 mg/m^3 .

Twin Boring Machines Equipped with Air Scrubbers

Unique methods of controlling dust from two twin boring machines have been demonstrated and are worth describing:

Two boring type continuous mining machines, each equipped with an identical exhaust system and different air scrubbing arrangements, were observed driving main entries in the Pittsburgh coal seam. Each machine was also equipped with a diffuser fan. See Figure 5-10.

The borer modifications consisted of each machine being fitted with built-in hooding arrangements which gathered air from behind the boring heads of the machine and directed it to the intake of a hydraulically-driven fan mounted on the top of the machine behind the operator's station (Figure 5-11). Reportedly, this fan had a capacity of about 10,000 CFM at no load. It was operating at about 3,300 RPM. The fan exhausted its air into spiral-wire-reinforced 20-inch ventilation tubing.

In one version, a 25-hp fan with a rated capacity of 15,000 cfm, in series with the machine mounted fan, discharged its air into a 20-foot length of 24-inch reinforced tubing. The 24-inch tubing was made to act as a scrubber by the introduction of about 1 to 2 gpm of water, through two solid cone spray nozzles, into the air in the tubing at the fan discharge. In the other version, the 25-hp fan discharged its air into an experimental multiple mini-cyclone type air scrubber. In each arrangement, the air from the system was discharged into the section return. The mine operator estimates the air capacity of the exhaust system to be no less than 6,000 to 7,000 cfm when the ventilation tubing is extended the required maximum length. If space and power is available, it is recommended that a fan of sufficient size and pressure be installed on the miner so as to eliminate the need for an auxiliary fan in the cross-cut.

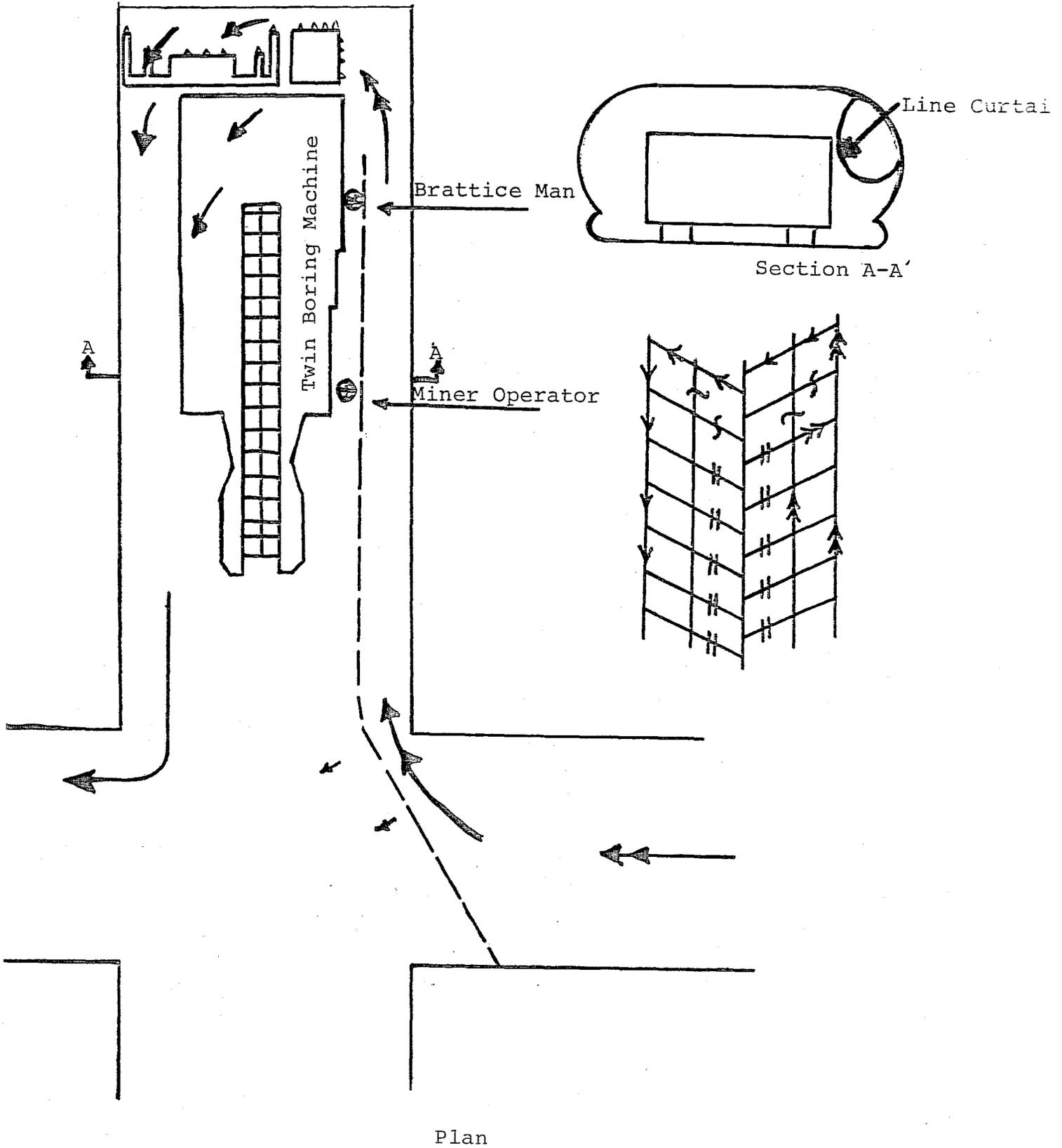


Figure 5-7 General Arrangement of Line Curtain on Operators Side

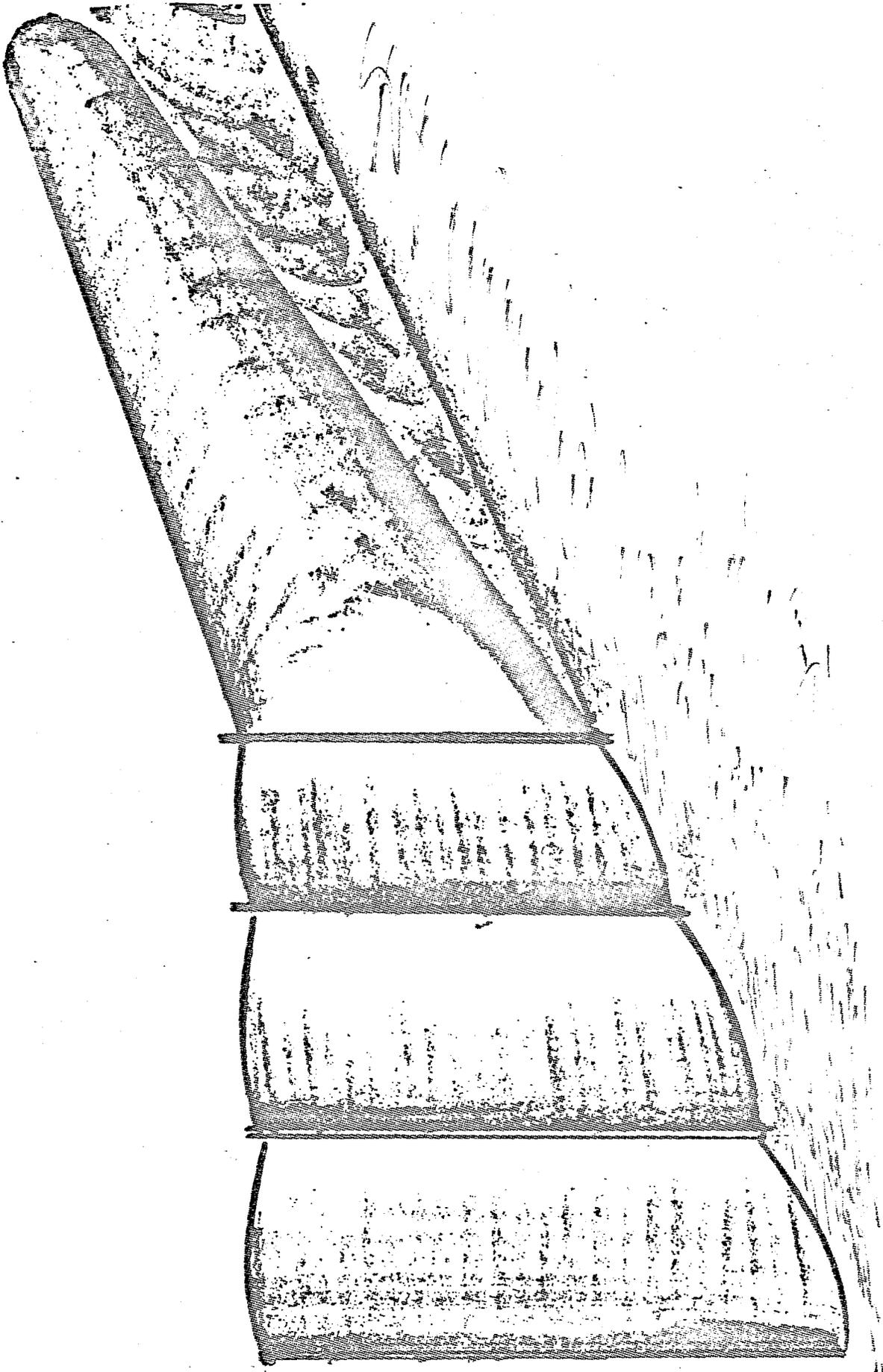


Figure 5-8 Sketch of Line Curtain Transition at Corner of Cross-Cut

FACE VENTILATION SYSTEM

Twin Boring Machine (Full Face)
Exhausting face dust controlled System

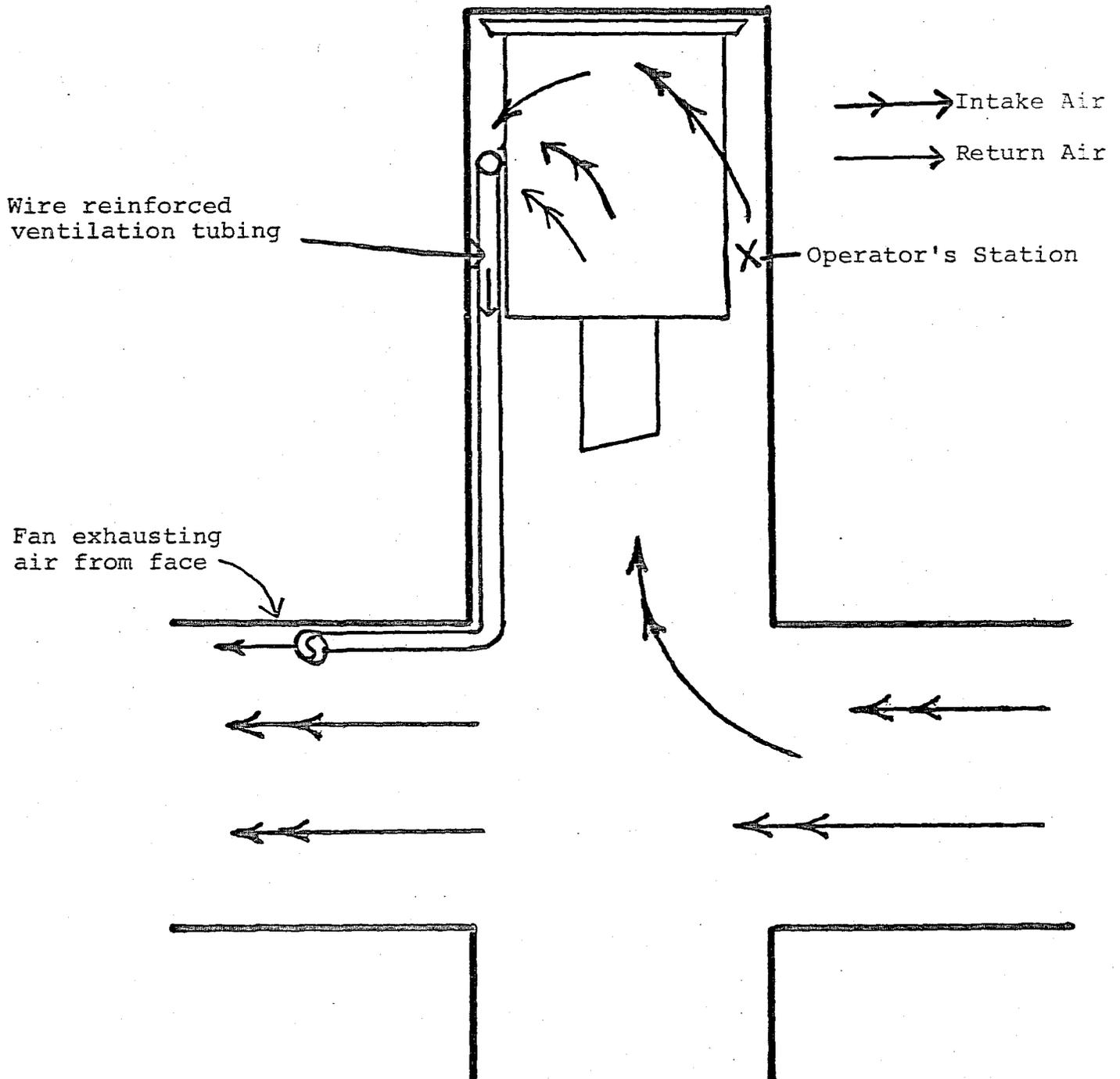


Figure 5-9

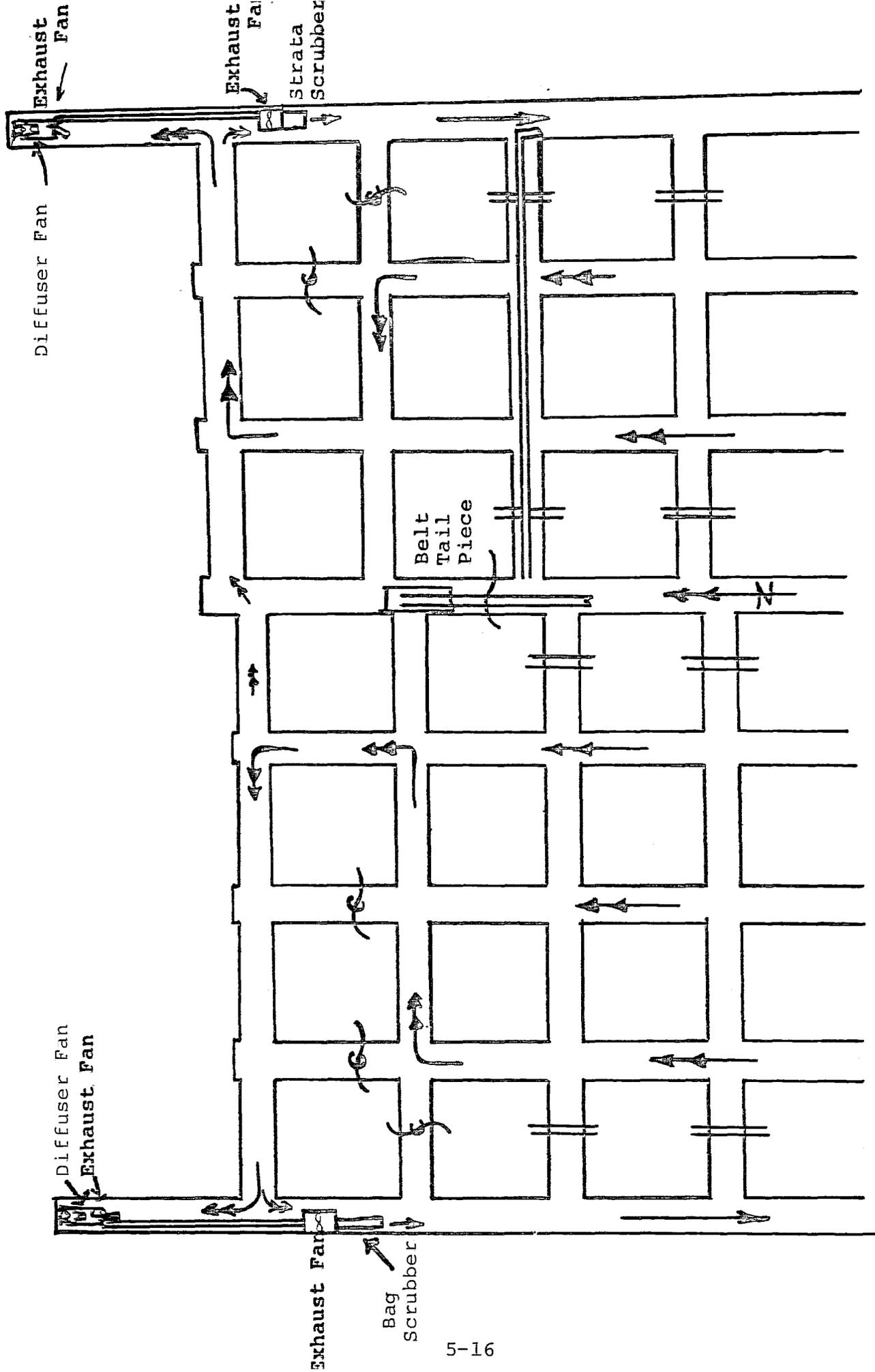


Figure 5-10 Ventilation System for Main Entry Development Using Marietta Twin Borers Equipped with Exhaust and Diffuser Fans.

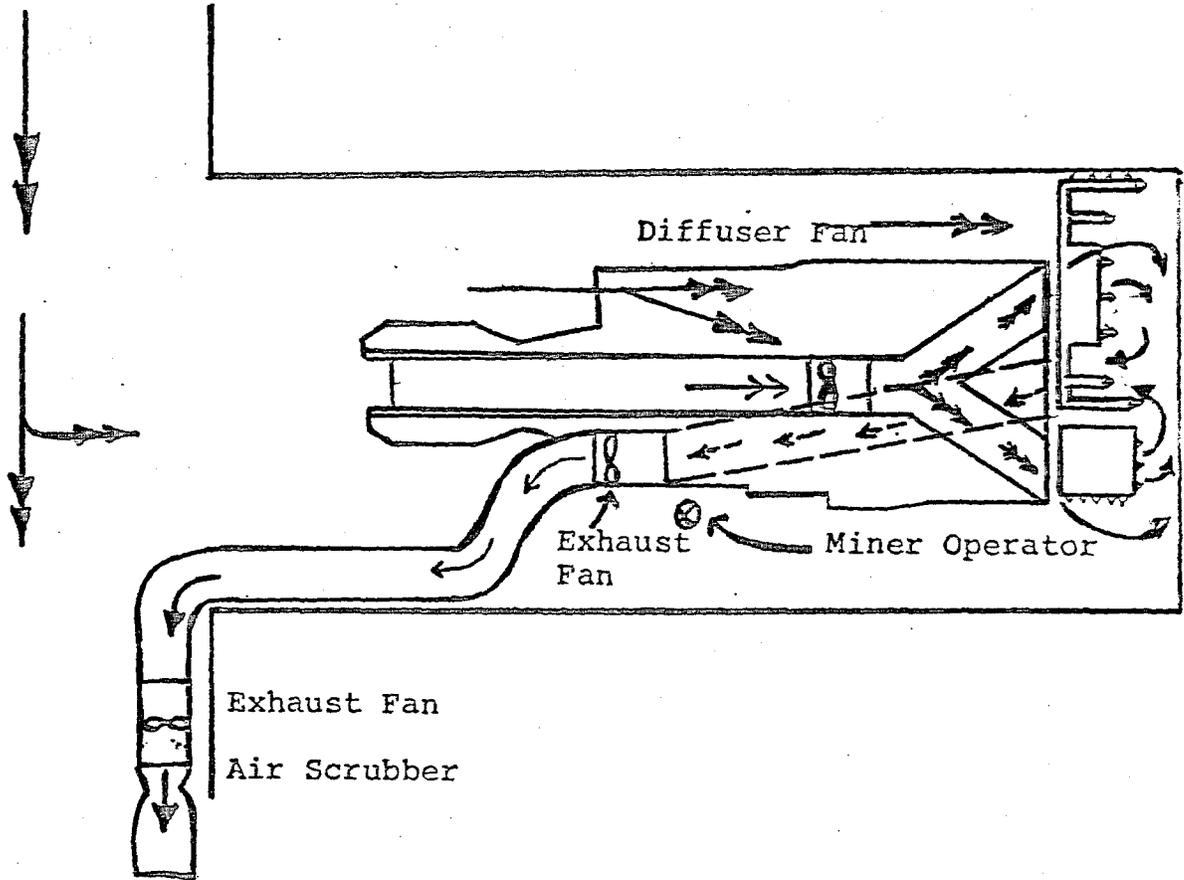


Figure 5- 11 Schematic of Ventilation Arrangement on Marietta Twin Borer in Pittsburgh Seam using two Exhaust Fans and 1 Diffuser Fan.

5.2.1.2 MULTIPLE ARM BORER (COLMOL)

Introduction

Though being phased out, the Colmol has found extensive use in the Johnstown, Pennsylvania area, as it works best in seams ranging from 42 inches to 52 inches in height. Making a 9'-6" cut and generally working in places 18 feet wide, two cuts are required to advance the full face. During the first (sump) cut the machine almost fills the area of the cut, making it virtually impossible to keep a brattice line in by the operator. During this time, ventilating the face of the cut is a serious problem, particularly if methane liberation is high.

Face Ventilation

A blowing face ventilation system favors methane control, but an exhausting face ventilation system must be used for satisfactory dust control, as the machine operator's dust exposure is minimized and the remainder of the crew are not subjected to dust laden return air. The face methane liberation problem has been minimized by use of a small diffuser fan having about a 900 CFM of air capacity. It is mounted at the back of the miner with inlet air duct work to either side of the miner and duct work to exhaust air parallel to the face, to either or both sides of the front of the miner. A Colmol face is ideally ventilated by practice of the following procedure: Use the minimum amount of intake air for effectively diluting the methane liberation at the face. That minimum amount must be the required 3,000 CFM. Use line brattice to exhaust the face air. Make the sump cut on the brattice line side which has been extended to the face. Widening the place must be completed by a series of offset cuts to maintain the brattice line. Recirculation of air by a diffuser fan if used, must be prevented at all times. This can be prevented by keeping the end of the line curtain beside or in by the inlet to the diffuser fan. Figures 5-12, 5-13, and 5-14 show three typical ventilation arrangements.

Water Sprays

There is very little room for mounting spray nozzles on this machine, except on the top of the head. If a cusper is not used, the nozzles may be conveniently directed to spray the entire coal face. Most success has been had with a solid cone spray. As few as 3 and as many as 14 spray nozzles and amounts of water ranging from 3 to 18 gallons per minute have been used. Ventilating the face by an exhausting system, which included a machine mounted diffuser fan if required for methane control, and using a minimum of 8 gallons of spray water per minute directed at the face should assure adequate face dust control.

NOT RECOMMENDED

FACE VENTILATION SYSTEM

Multiple Arm Borer (Colmol)

Blowing System
Face Dust Not Controlled

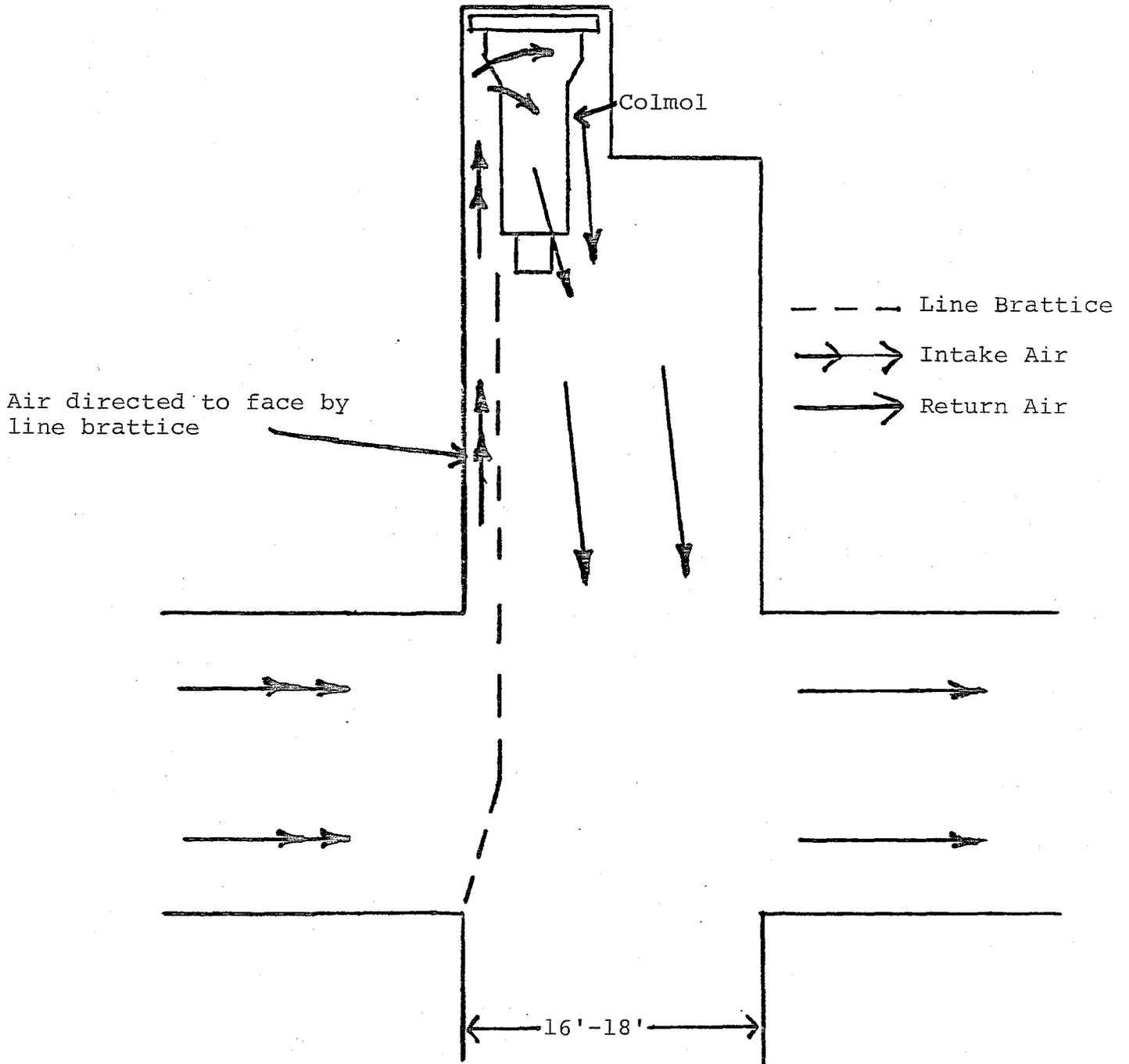


Figure 5-12. Blowing Ventilation System

RECOMMENDED

ACE VENTILATION SYSTEM

Multiple Arm Borer (Colmol)

Exhausting system
Face dust controlled

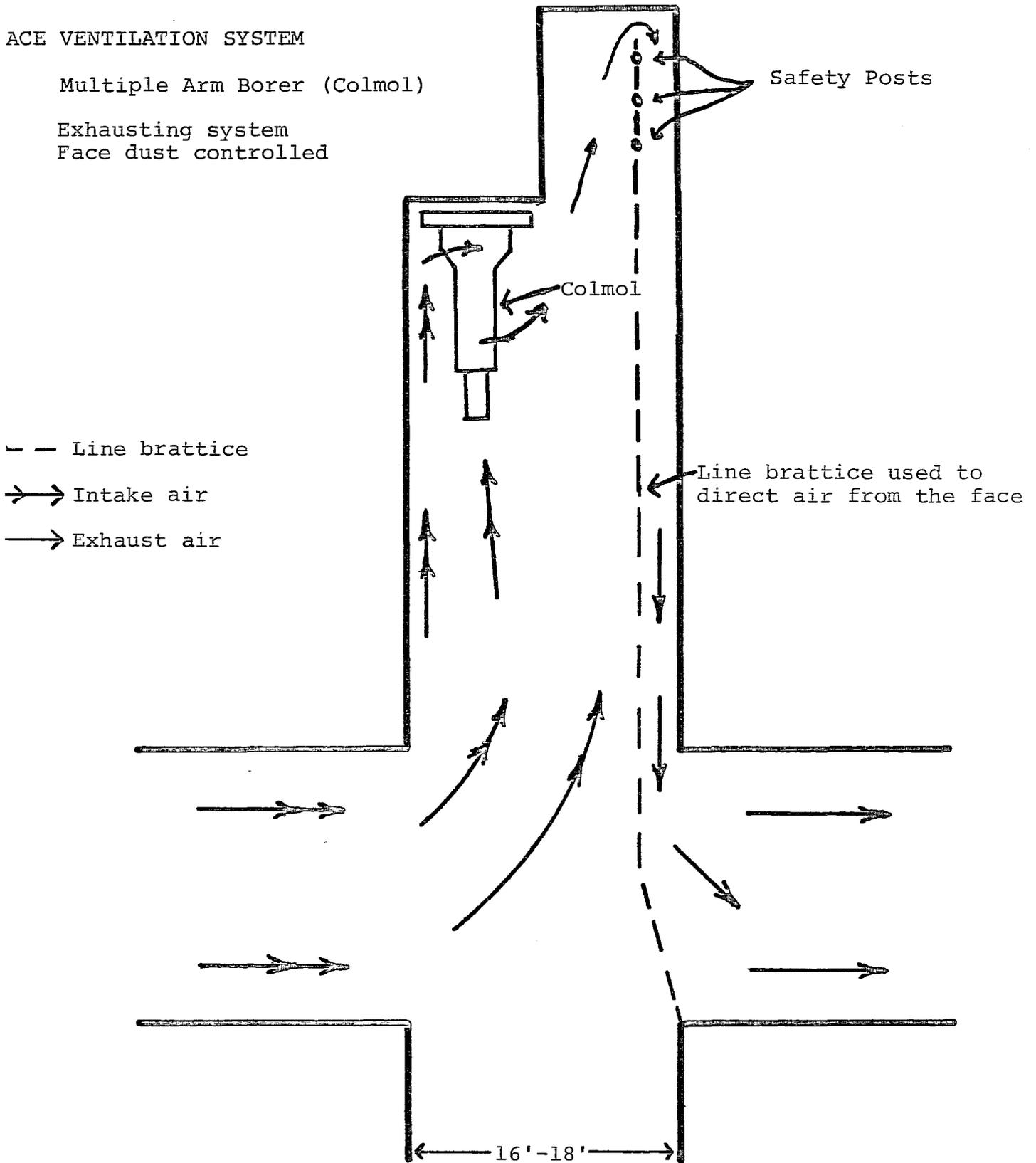


Figure 5-13. Exhaust Brattice

FACE VENTILATION SYSTEM

Multiple Arm Borer (Colmol)

Exhausting system with diffuser fan
Face dust controlled

--- Line brattice

→ Intake air

→ Return air

-•-•- Fan ducting
Small Diffuser Fan

Safety Posts

Line brattice used to direct air from the face

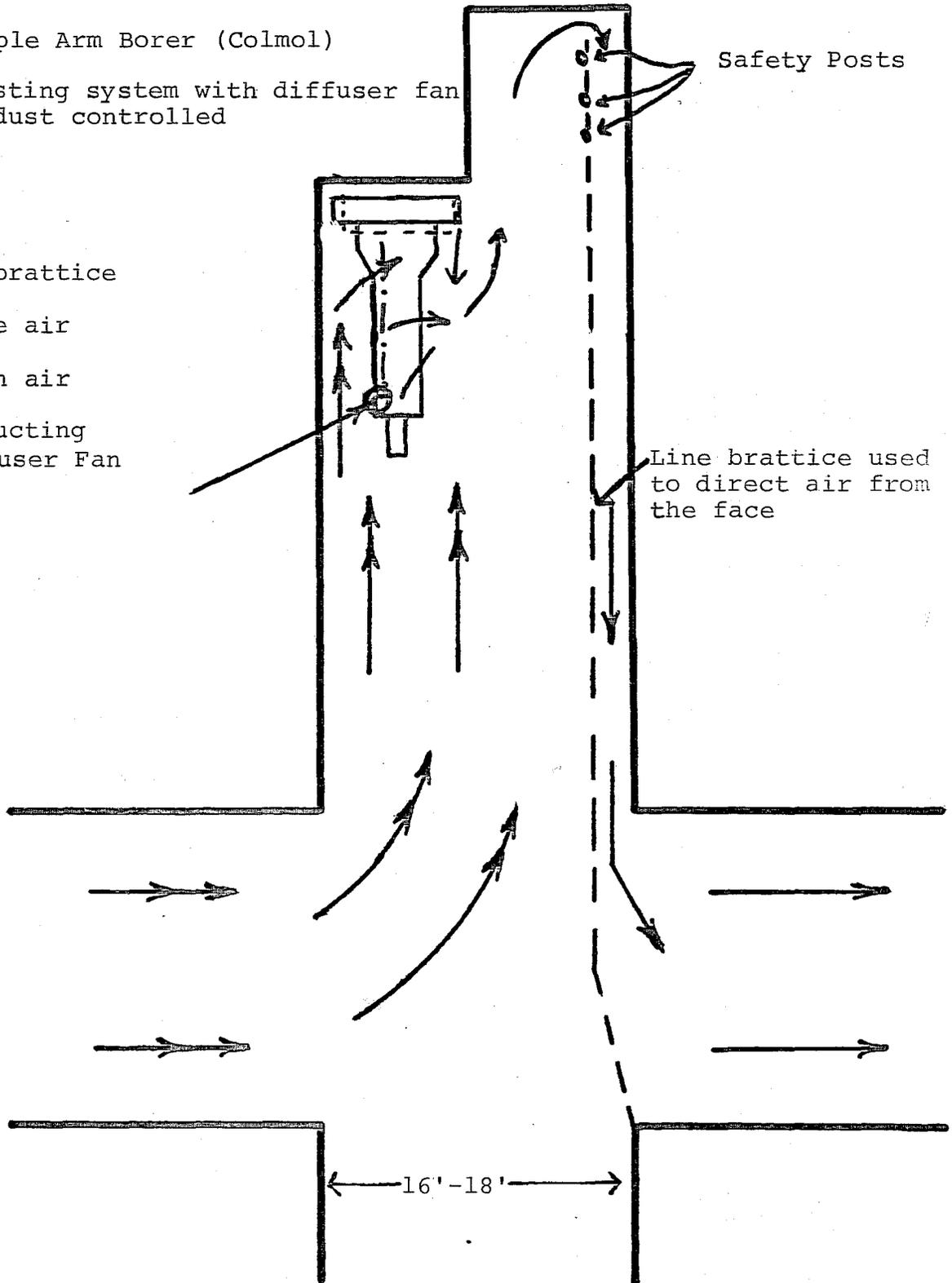


Figure 5-14. Exhaust Brattice and Diffuser Fan.

Dust Control Results

Of all the different types of continuous mining machines, this is the type that involves the most difficult dust control problems. The reason for this is the lack of working room around the machine. Only where special attention to details is taken is a dust level of 3.0 mg/m^3 being maintained constantly.

5.2.2 MILLING MACHINES

Introduction

Milling machines have either oscillating or non-oscillating heads. The oscillating head machine is being replaced by the non-oscillating head machine, probably because of simpler design which affects costs, maintenance, etc. The oscillating head type makes a cut of about 9 1/2 feet wide, whereas cuts up to about 15 feet wide can be made with the other type. The cutting height capability of each ranges from about 3 feet to upwards of 10 feet for some models. Places 14 feet to 18 feet wide are usually driven when using these machines. Except when the wide head machines are used, two cuts are required to advance a full face. There being ample working space around the oscillating head machines, choice of a face ventilation system is not restricted for any physical reason, except for limited head room for installation of dust collecting devices on low coal machines. This exception also applies to non-oscillating head machines. The wide bodies on some models of the non-oscillating machines require that air be coursed at the immediate face by ventilation tubing.

Face Ventilation

A blowing face ventilation system has proven to be capable of maintaining acceptable dust control at the face only when supplemented with a face dust collecting device. The majority of coal mine operators are using line brattice for exhausting air from the face, and report excellent results. Where used, auxiliary fans, operated exhausting, reportedly also are providing excellent results.

Examples of successful exhausting face ventilation systems for oscillating head and non-oscillating head milling machines are shown in Figures 5-15 and 5-16 respectively.

Water Sprays

All manufacturers of milling machines are installing water systems on their equipment on order, which includes filters, pumps, and spray nozzles as desired. Their standard systems were found to be satisfactory in most instances.

Sixteen to forty spray nozzles, depending on type of machine and representing every manufacturer were being used on these machines. The amount of spray water being used varied from 14 to 30 gallons per minute and water flow pressures ranged from 75 to as high as 300 pounds per square inch.

Face Ventilation System

Oscillating -type milling miner
Exhausting system
Face dust controlled

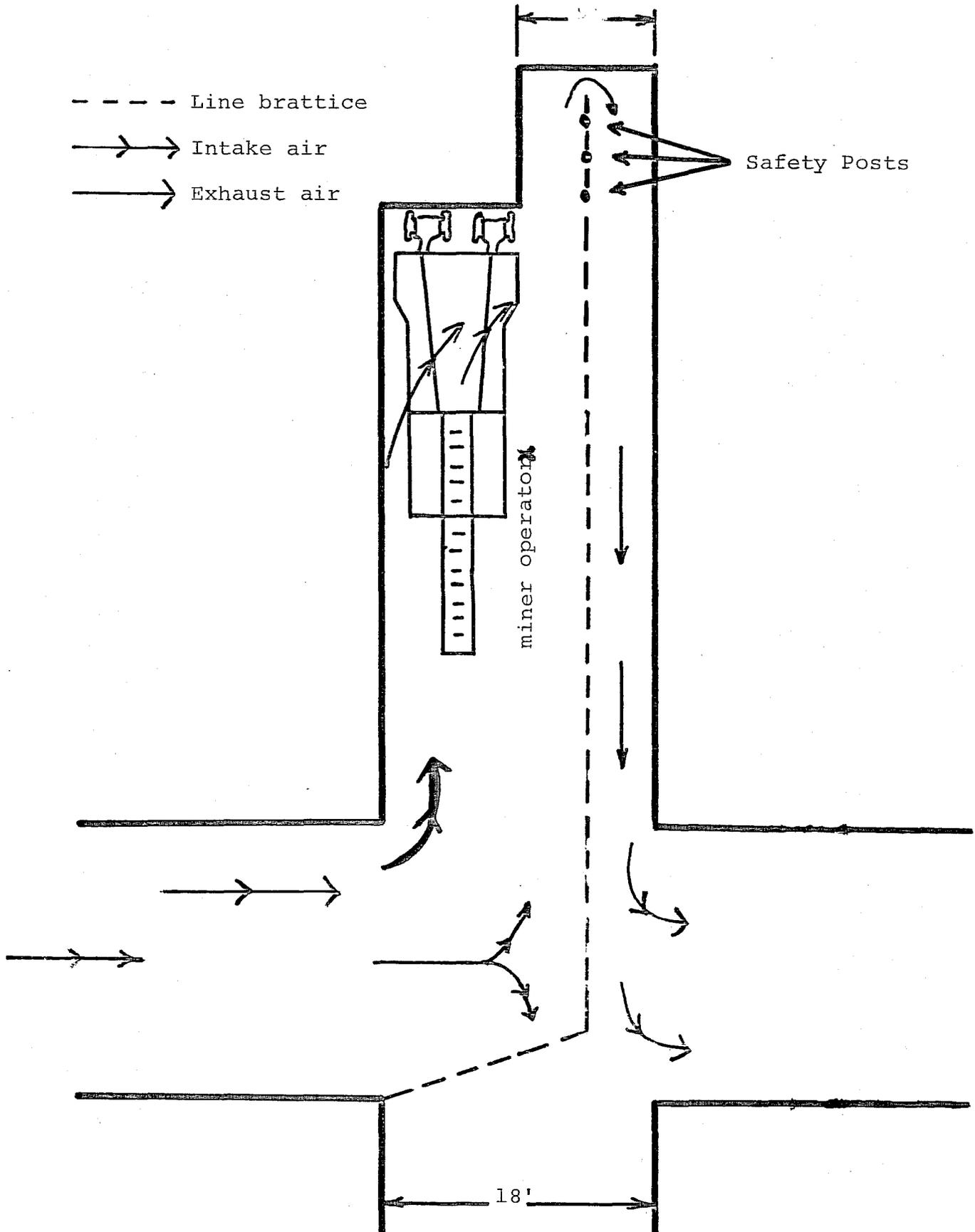


Figure 5-15. Exhaust Brattice

FACE VENTILATION SYSTEM

Non-oscillating type milling miner

Exhausting system
Face dust controlled

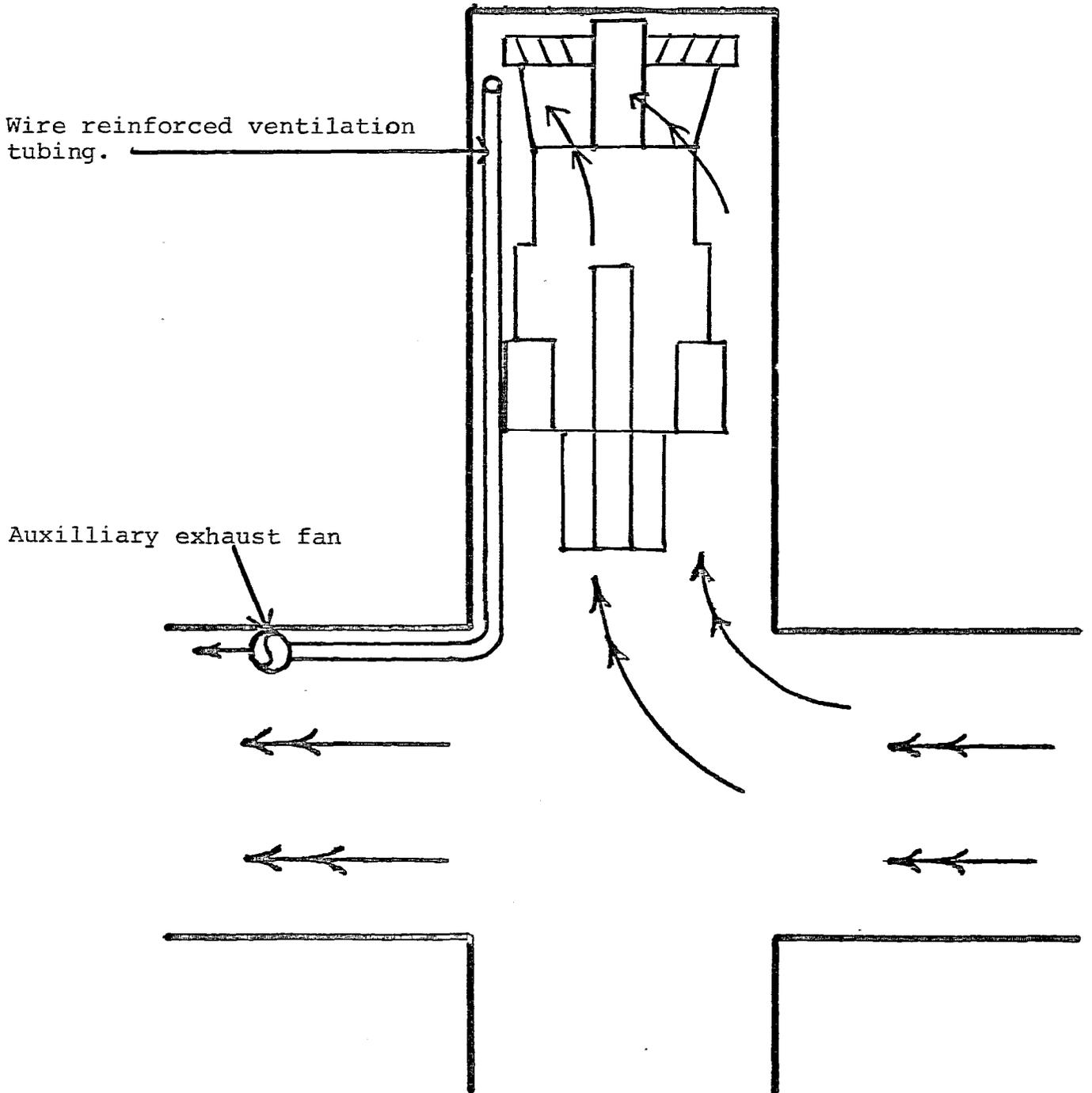


Figure 5-16. Exhaust Fan System

Experimentation with nozzles continues at the mines, particularly for determination of nozzle size and type of spray pattern best suited for local conditions. Local conditions are so varied that no hard and fast rule can be given for choice of nozzle. A general rule for guidance might be to provide a minimum of 2 to 4 gallons of water per minute for each ton per minute mining capacity, as rated by the machine manufacturer.

Dust Control Results

No operator using a blowing face ventilation system routinely reports attaining high risk samples of 3.0 mg/m^3 or less. Operators report high risk samples ranging from 2.5 to 4.0 mg/m^3 . No one reports attaining high risk samples of less than 2.0 mg/m^3 consistently.

Three systems of controlling respirable dust exposure by the use of a "Strata Scrubber", a Gundlach Scrubber and a unique water spray system, have proven to be of value. A description of these methods follows:

1. Strata Scrubber

The Strata-Scrubber is an available device which reportedly can reduce face dust to satisfactory levels. On a Jeffrey 120-M Heliminer, it is factory installed and mounted centrally in the cutting head boom. It consists of a hydraulically driven fan, with an air capacity of about 4,000 cfm per minute, which draws dust laden air from the cutting head area below the boom and passes it through bank of small cyclonic scrubbers, developed by the Donaldson Company, Inc. Cleaned air is exhausted toward the back and to the sides of the machine over the top of the boom. A slurry from the scrubbers is dropped onto the coal on the conveyor.

Tests of operating performance of this arrangement have been conducted. Details of test procedure and significant data were available and volunteered by one company. For comparison of resulting dust levels, the dust exposures of the continuous miner operator were determined for shifts when the scrubber was and was not operated. The face was ventilated by an auxiliary fan exhausting air from the face through 16" solid fibre-glass tubing. The fan had a capacity for exhausting about 7,000 cfm of air through 100' of the tubing. Sampling technique, as required by the Federal Coal Mine Health and Safety Act of 1969, was followed.

With the scrubber not operating the operator's exposure ranged from 0.5 to 9.8 mg/m³ and averaged 4.15 mg/m³ for 10 days of sampling. With the scrubber operating the operator's exposure ranged from 0.1 mg/m³ to 1.6 mg/m³ and averaged 0.7 mg/m³ for 15 days of sampling. Thus the scrubber reduced his exposure level by a factor of 6 and maintained his exposure below the required standard of 2.0 mg/m³ at all times.

2. Gundlach Scrubber

The model 30-SC Gundlach Scrubber is a development of the T. J. Gundlach Machine Company, Belleville, Illinois. It consisted basically of a hydraulically driven rotor mounted on the top of the continuous miner cutting-head-elevator with its inlet ductwork built into the elevator. Dust laden air is drawn into the rotor through two rectangular 4-inch by 15-inch ports in the sides of the elevator just above the gathering head and 4 ports in the bottom of the elevator and over the gathering head and conveyor. Scrubbed air is discharged to the left side of the miner through 3 10-inch diameter ventilation tubes.

The specifications of the unit, as provided by the manufacturers are as follows:

Model No.: 30-SC Topmount Scrubber
Housing Dimensions: 15" high by 47" diameter
Rotor Dimensions: 30" diameter
Operating Speed: Approximately 2,000 rpm
Hydraulic Drive Requirement: 24gpm at 2,000 psi
Air Capacity: 15,000 cfm
Water Requirements: 3 to 8 gpm
Weight: 1,700 pounds

The operating principal of the unit is as follows:

"Dust-laden air is drawn through the unit in the same way as does a centrifugal blower. A very unique configuration of the rotor combines water injected into the suction eye with the dust in the air. The dust-wetting action of the rotor is based on the combined principals of impingement and venturi action. The rotor is so designed as to prevent plug-up and can be operated for many shifts without cleanout depending on mine conditions. The wetted dust and scrubbed air is discharged over the side of the miner through flexible ducts to impinge on the mine floor or rib where the heavier droplets of wetted dust and water separate from the air."

Figure 5-17 shows the general arrangement of the scrubber as mounted on a Joy 10CM miner.

Figure 5-18 and 5-19 show the spray nozzle placements on the head and pan of the miner, respectively. The 4 spray nozzles used in the scrubber are directed toward the intake air being drawn through the ports on the sides of the elevator.

Table 5-1 shows the number, type and flow rate of each of the nozzles used and the total flow rate of all the nozzles used.

3. Unique Water Spray System

A unique water system installed on a Joy 11 CM continuous miner was observed advancing entries in the Winefrede Coal seam.

The machine was originally fitted with an internal water system to direct water to the cutting bits to reduce dust generation. Plugging of holes or nozzles directing water to the bits is a problem which has not been resolved. To minimize the problem, the water holes in the heads were plugged and the water was channeled into two 1/2" diameter steel pipes wrapped around the base of each cutter head scroll. Each pipe was about 54" long and jets of water were directed to the coal face through about 1/16" diameter holes drilled in the pipe on 4 3/4" centers. This system supplemented the conventional spray water system which consisted of 19 spray nozzles mounted on the top and sides of the cutter head, and in the conveyor throat.

The machine, so fitted, was observed while driving a crosscut. Air was exhausted from the face behind a line curtain that was extended to the face before mining was begun. It appeared that the quantity of air directed to the face, exposed the continuous miner operator to very little generated mine dust. Also, it appeared that the water was effectively minimizing dust generation at the face. The coal being loaded into shuttle cars was damp and relatively dust free.

5.2.3 RIPPING-TYPE CONTINUOUS MINERS

As prolific a dust maker as this machine seems to be, investigations have shown it to cause fewer dust control problems than the milling-type miners. If dust control recommendations indicated for milling machines are followed, satisfactory dust control should result. A typical exhaust ventilation system is shown in Figure 5-20.

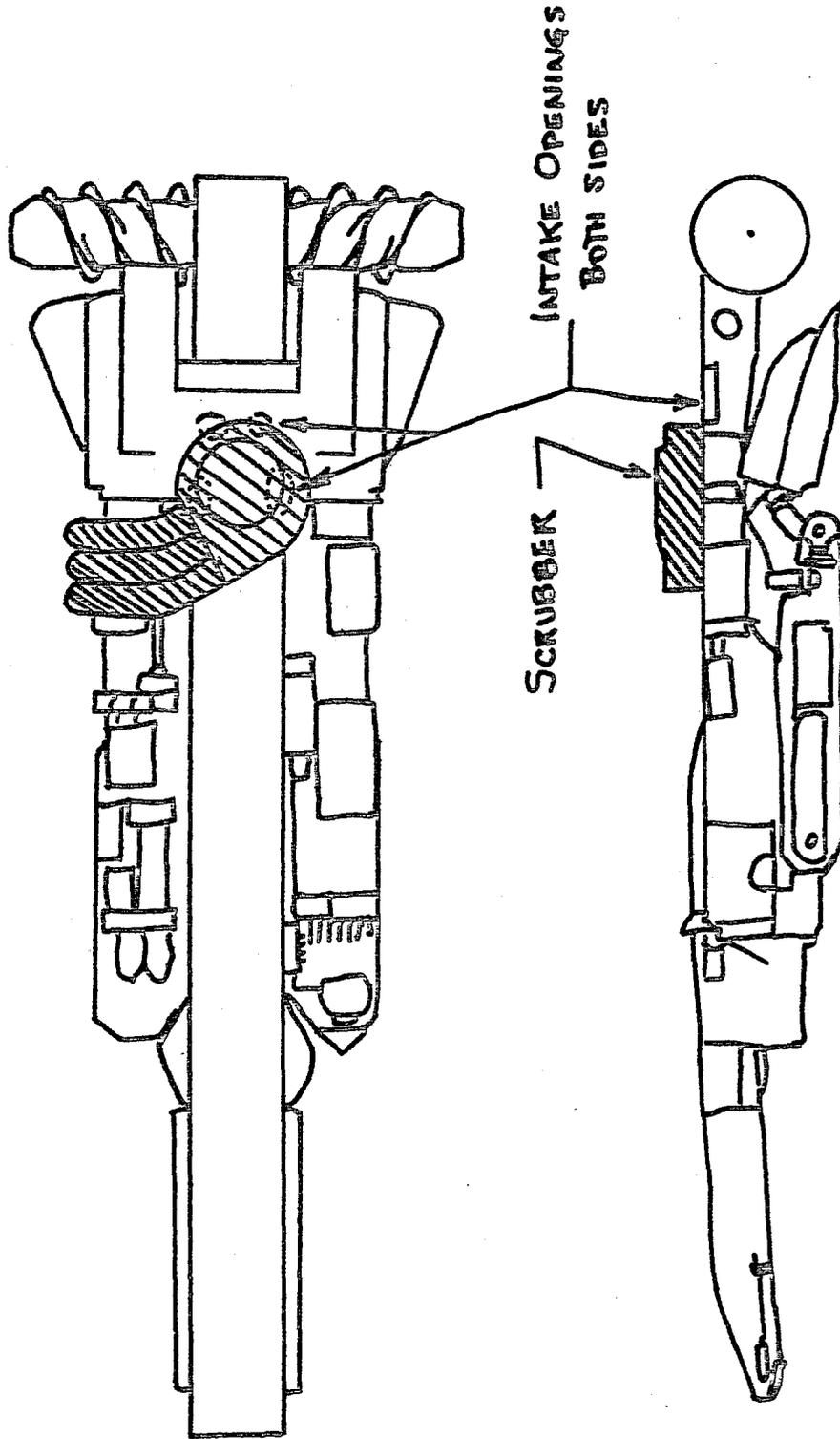


Figure 5-17 General Arrangement of Experimental Scrubber Mounted on Joy 10CM

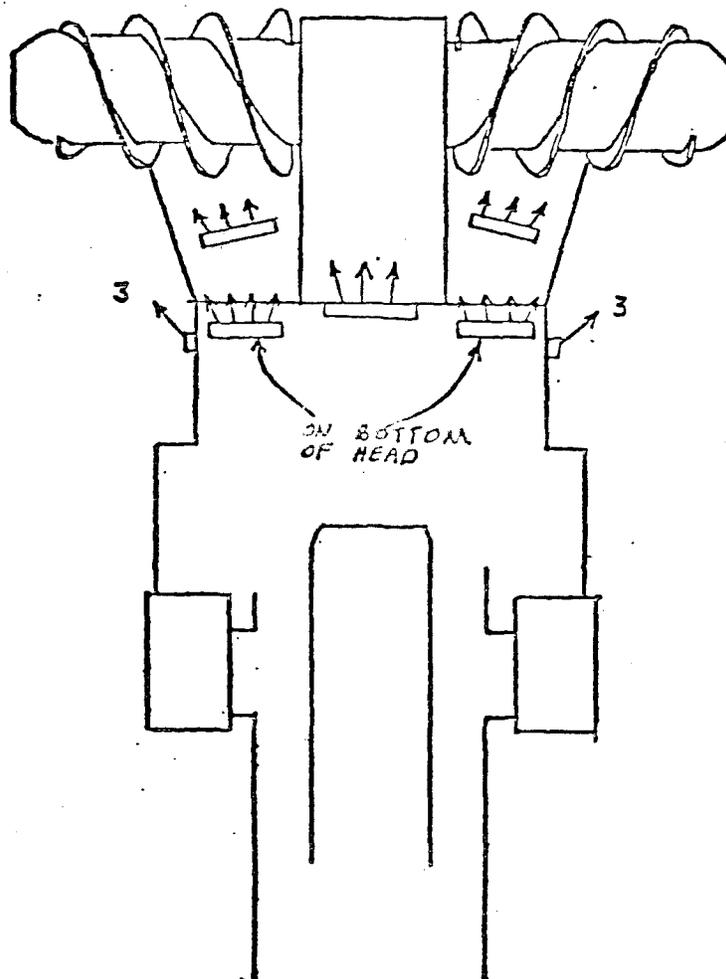


Figure 5-18 Spray Nozzle Arrangement On Head of Joy 10CM Miner

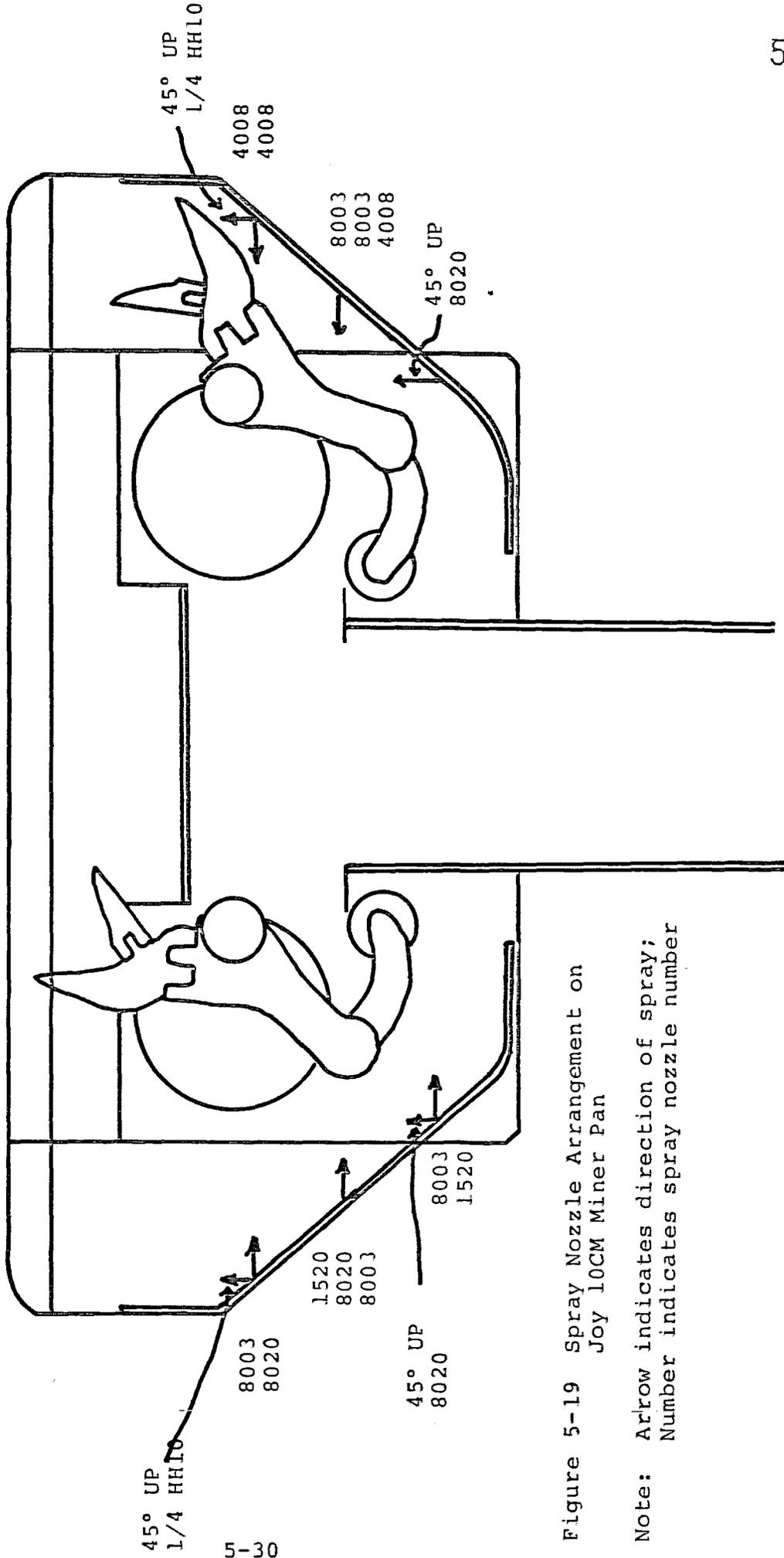


Figure 5-19 Spray Nozzle Arrangement on Joy 10CM Miner Pan

Note: Arrow indicates direction of spray; Number indicates spray nozzle number

5-30

Table 5-1. Joy 10CM Spray System Nozzles

<u>Company</u>	<u>Cat. No.</u>	<u>Type</u>	<u>Spray Angle</u> <u>On Head of Miner</u>	<u>Flow Rate at</u> <u>250 psi, gpm</u>	<u>No. Total</u> <u>Used</u>	<u>Total</u> <u>Flow, gpm</u>
Joy Mfg.	28379	Full Cone	20°	0.75	19	14.00
Spraying Systems Co.	1/4VV 8003	Flat	90°	0.75	5	3.75
do	1/4VV 4008	do	50°	2.10	2	4.20
do	H 1/4U 1520	do	20°	5.00	1	5.00
do	H 1/4U 8020	do	85°	5.00	4	20.00
do	1/4 HH 10	Full Cone	60°	4.70	2	9.40
Jeffrey Mfg.	446780	Full Cone	20°	0.75	4	3.00
			<u>On Scrubber</u>			
				TOTAL	37	59.35

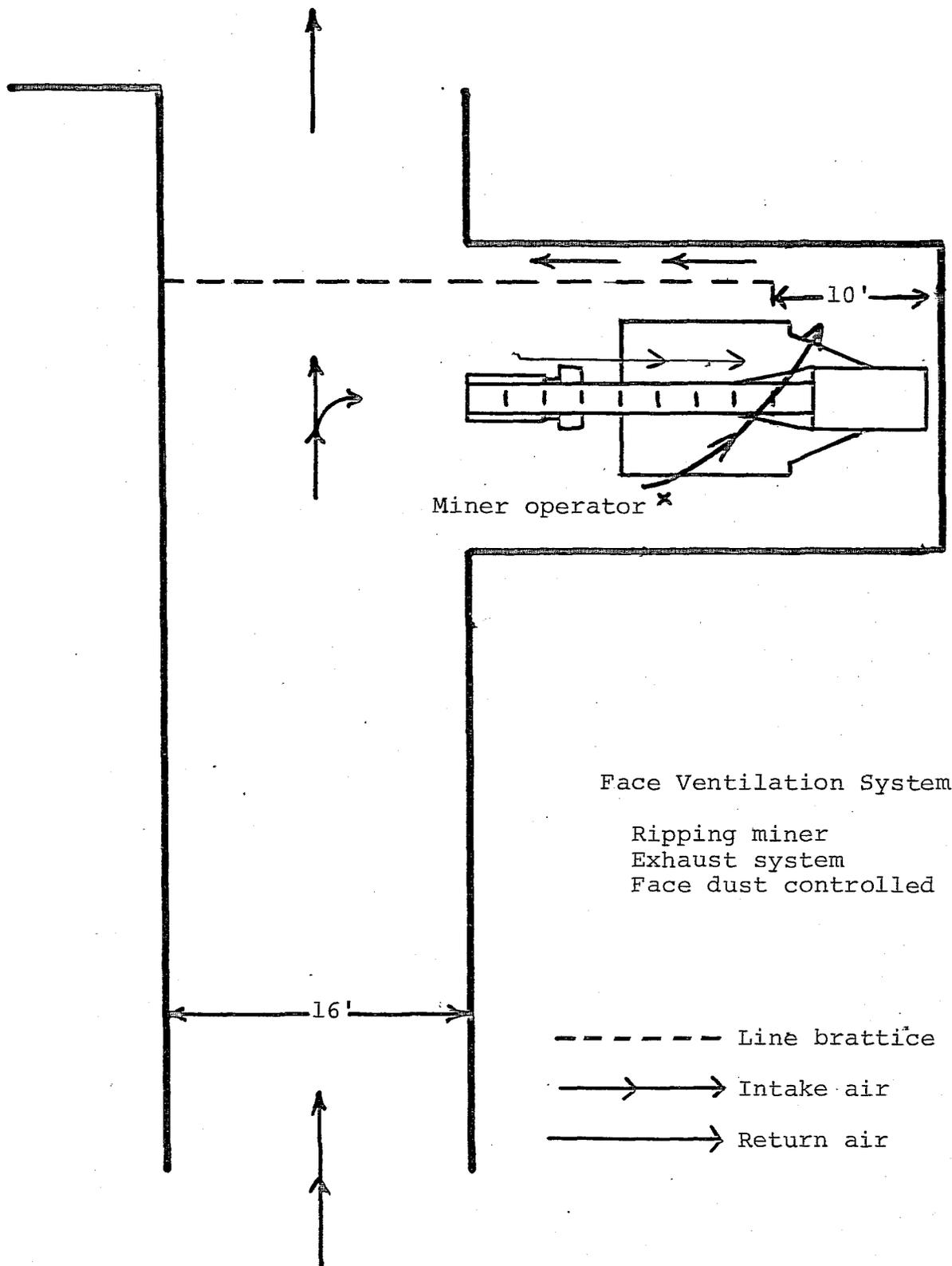


Figure 5-20 Exhaust Brattice

5.2.4 AUGER-TYPE MINER

Introduction

The auger-type miner makes possible the mining of coal seams ranging from 26 inches to about 48 inches in height some of which probably could not be mined profitably by use of any other equipment or method. Acceptable solutions have been found for most of the mining problems connected with use of the auger miner. The satisfactory control of dust from the mining process is questionable. Width of the working faces generally ranges from 24 feet to 30 feet, and it is difficult, if not impossible, to ventilate the entire face with either a line brattice or any other installation that has no objectionable features. These features are discussed under the subheading of face ventilation which follows. This machine sumps into the face at one side, makes about a 4-foot deep cut across the face and repeats the cycle in the opposite direction. As it travels across the face, it is necessary for a jack setter to remove the temporary face supports for clearance, and after it has passed for a jack setter to install temporary supports to the face behind the miner.

Face Ventilation

The wide faces required for operation efficiency, and the need for removing and replacing temporary supports (with jack setters working on either side of the augering machine as it moves across the face) are the main causes of the dust control problems. Blowing or exhausting face ventilation systems are being used with about equal, but not satisfactory, control of the dust at the immediate face. Figure 5-21 shows a method of providing ventilation by a blowing system. The air is reversed in an exhausting system by using a double line curtain as shown in Figure 5-22. When it is used, face crew members, other than the two jack setters, are not exposed to the dust being dispersed into the air by operation of the miner. Neither jack setter can be protected from the dust by directing the air flow in either direction across the face or by adequate air volume dilution. For effective control, dust from the machine must be adequately suppressed at its source. At this time, water or water with a wetting agent added are the only available means of suppressing this dust. The use of foam for preventing dispersion and the use of dust collecting systems for locally confining the dusty air, passing it through a cleaning device and exhausting it in the working place are being investigated.

Water Sprays

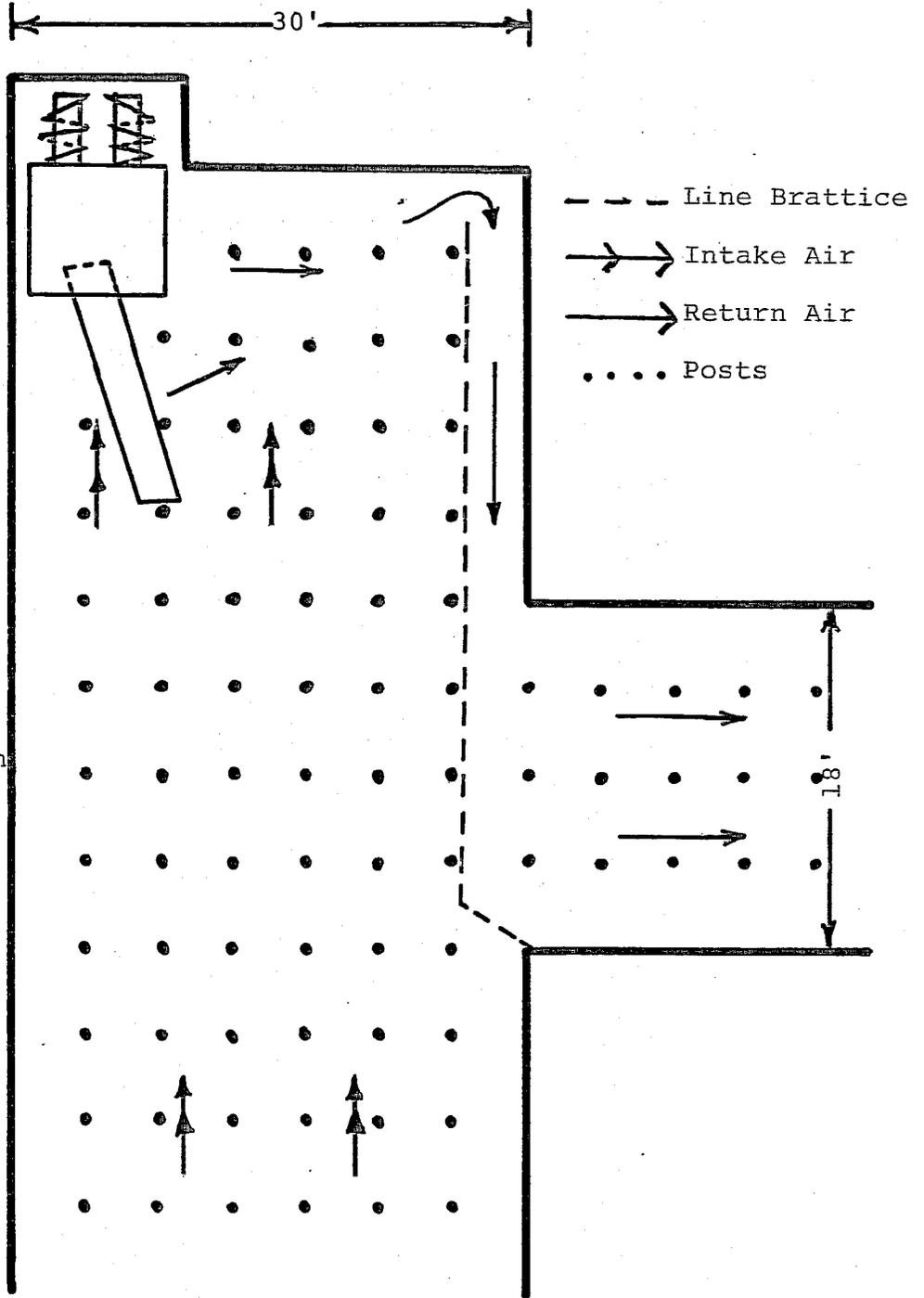
Auger miners are delivered with factory installed spraying systems. These are sometimes modified at the mines by adding additional nozzles or using a type different from the original. Also older models have been fitted with systems of local design. A flat shaped spray, having a wide spray angle, has been found to be best suited for the purpose. Nozzles are mounted across the top of the machine to spray the area between the augers and at each side of the machine to spray the coal faces where they are cut by the augers.

All reports from operators indicate that the dust exposure of all crew men except the jack setters can be maintained at a dust level not exceeding 3.0 mg/m^3 without difficulty, provided a sufficient amount of water is used. A minimum of 3 gallons of water per minute must be used during cutting for satisfactory control. To assure an adequate supply of spray water, high pressure pumps are being factory installed, when desired. Uncontrolled dust exposure of the jack setters remains a problem.

FACE VENTILATION SYSTEM

Auger-type miner
Exhaust System
Ventilation cannot effect satisfactory control

Auger Miner



Notes:

One of two jack
setters works in dust
laden air all times
unless dust generation can
be adequately suppressed
by water or other means.

Figure 5- 21

FACE VENTILATION SYSTEM

Auger-type miner
Exhausting System

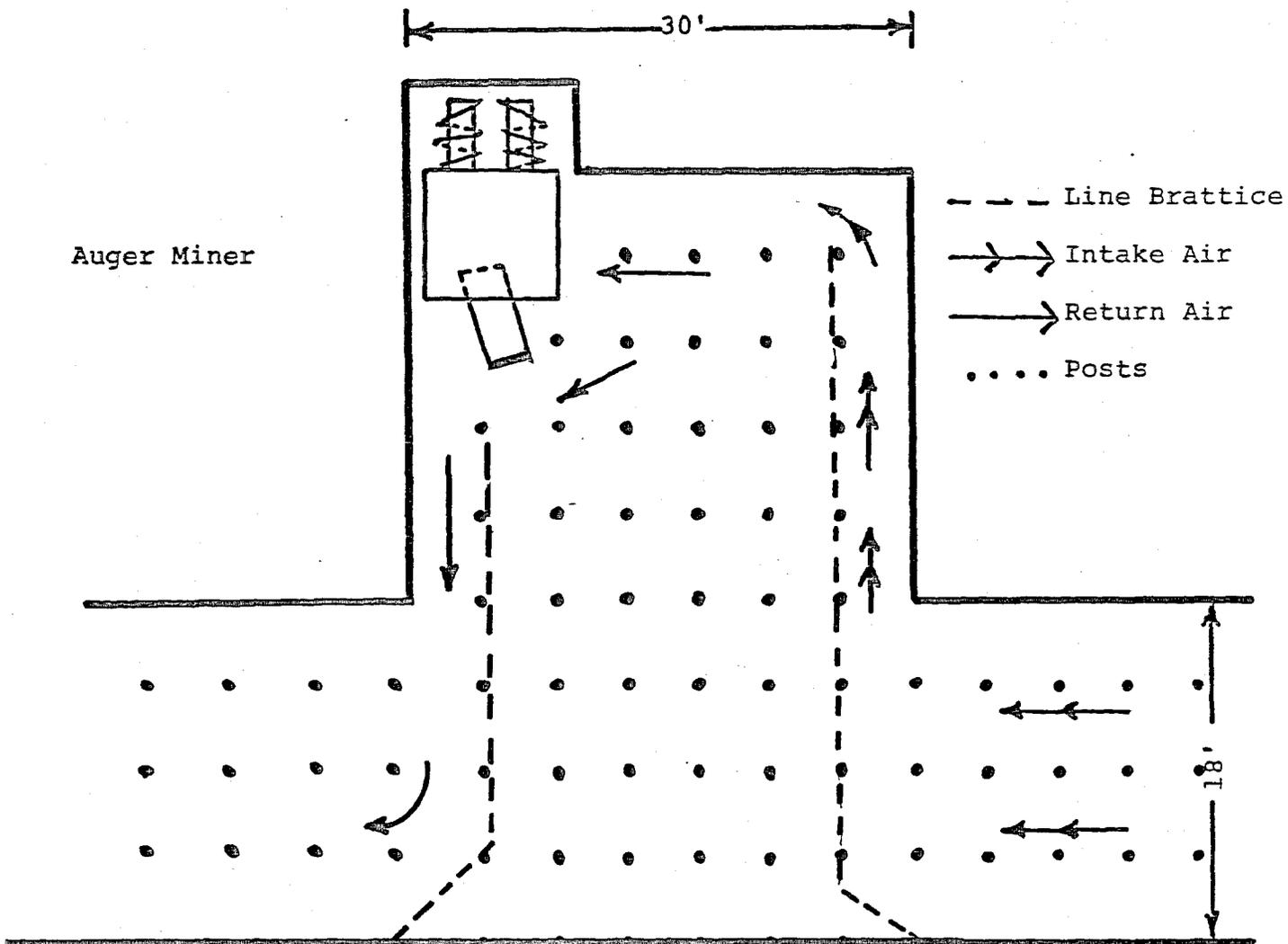


Figure 5-22

5.3 LONGWALL MINING

5.3 LONGWALL MINING

Introduction

Longwall mining, though not a recent innovation, is still in a development stage regarding dust control. At this time, much work is in progress to develop satisfactory procedures to be followed for controlling local dust problems. Before intensive efforts to attain satisfactory control were begun, a Bureau of Mines study revealed high risk sampling results ranging from 0.8 to 12 mg/m³. At the conclusion of each study, the operator was advised of the sampling results and was offered suggestions for improving effectiveness of his control methods. The investigation is continuing by conducting additional studies to determine the success of further efforts. At its conclusion, the Bureau of Mines plans to publish a detailed report of its findings with recommendations for effective control practice.

Face Ventilation

Ventilation requirements of longwall sections are not restricted, except for volume. They are mined on retreat. This permits either the head entries or both the head and tail entries to be used as air intakes. If the head entries only are used as intakes, the tail entries must be used as returns. Both head and tail entries are used as air intakes, and seems to be the system preferred. The tail entries serve as auxiliary intakes, to reduce gas emission from the coal block and provide intake air ventilation for the tail motors. Section ventilation being used, to obtain satisfactory control, ranges from 30,000 CFM to 70,000 CFM of air. 25,000 CFM to 40,000 CFM of this air is directed across the longwall faces. Ventilation requirements, as indicated by the control survey, appear to be similar for both shearer and plow operations, except for gassy situations. A longwall ventilation system is shown on Figure 5-23.

Water Sprays - Longwall Shearers

Dust dispersed by shearing drums is minimized by installing cowls at the backs of the drums, spraying open edges and insides of the cowls with water, and directing water at the coal where it is being cut by the bits. Operators using these cowls also report that sampling results do not indicate that suppression efficiency of bit flushing by water fed through the drum, is greater than effectively used water sprays. In addition to suppression of the shearer dust, which should result in dampened coal, water sprays should be used at the discharge end of all coal conveyors. The amount of water used for successful application ranges upwards from a minimum of 35 gallons per minute. Pressure required varies with nozzle characteristics but higher pressures effect better control.

Water Sprays - Coal Plow

At this time, to suppress the dust from coal plowing, nozzles are installed at 5-10 foot intervals along the longwall face with the water sprays directed at the coal face and conveyor line. This, obviously, is an inefficient use of water and dust suppression in most instances is not adequate. A means should be developed for the use of the water at points where it will have the greatest affect, such as the coal plow. It is understood that one operator is attempting to do this by installing an automatic water control system. The control valves, for each of the spray nozzles installed along the face, are to be activated by the passing of the coal plow. This will allow for more effective use of water without increasing its consumption. Undoubtedly, other methods will be developed for supplying water to the coal plow itself, as efforts continue.

Dust Control Results - Longwall Mining

During the coal mine dust control study, only two mine operators reported consistent and adequate dust control. One operator reported shearer-section's compliance samples ranging from 1.2 to 1.7 mg/m³. One operator, using a coal plow, reported maintaining compliance with the 3.0 mg/m³ dust standard. One operator in a paper presented at the AMC, 1971 Coal Convention in Pittsburgh, Pennsylvania, described development of a satisfactory dust control procedure. This paper outlines in detail the control practice required to maintain a double-drum shearer-section in compliance with the 3.0 mg/m³ standard.

Hubbard, John S. Longwall Experience at Gateway Mine. Proc. Coal Convention, American Mining Congress, Pittsburgh, Pennsylvania, May 16-19, 1971, 7 pp.

The development of dust control procedures acquired for adequate dust control at a double drum shearer longwall face is described.

The changes made to the original plans were as follows:

1. The water supply for the section was improved by replacing the original 2-inch section water line to a 4-inch line, replacing the 1-inch water hose to the shearer with 1 1/2-inch hose, and installed water filters. The section is now provided with a flow of 48 gpm of water at a pressure of 190 psi.
2. Ventilation of the section was improved to obtain 25,000 cfm of air across the face with 30,000 cfm of air sweeping the gob and 40,000 cfm of air returned through 3 entries paralleling the tail gate entry. 15,000 cfm of intake air are coursed through the tail gate entry and 55,000 cfm of intake air are coursed through the head gate entries.

3. More spray nozzles were added to the shearer. It is now fitted with 11 nozzles on each drum to flush the cutting bits, 6 nozzles for spraying the coal face between the drums, and 12 nozzles in each of two headers directed to wet the coal face at each end of the shearer.
4. Curtains were hung in the walkway on every 10th chock to direct the air onto the pan line.
5. Recirculation of air just inby the end of the face caused by the conveyor-motor cooling fan was stopped by a box enclosure arrangement.
6. A spray nozzle was installed at the head gate to maintain face air humidity during idle periods.

If the developed procedure is followed, compliance with the 3.0 mg/m³ health standard is achieved.

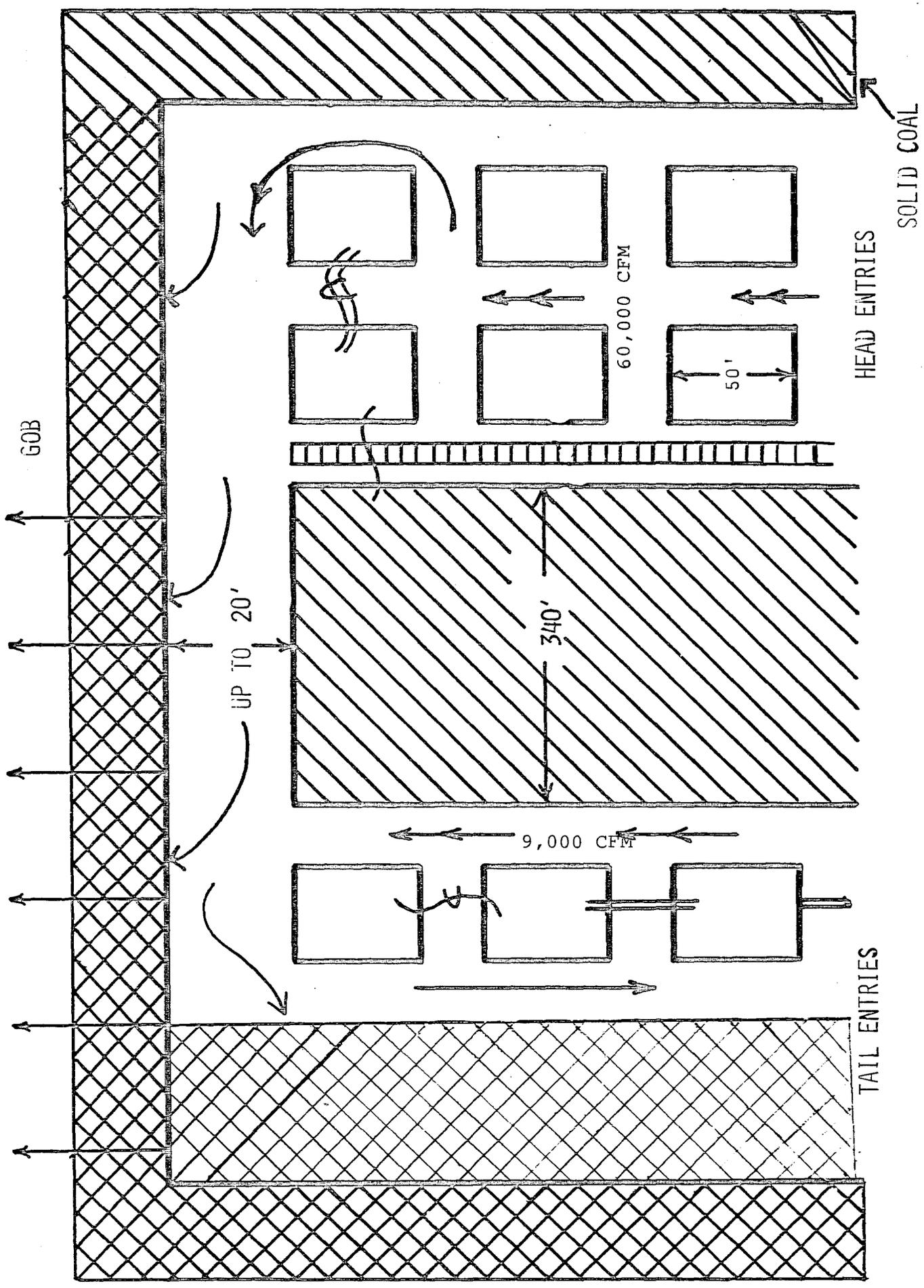


FIG. 5-23 LONGWALL VENTILATION SYSTEM

5.4 MISCELLANEOUS

5.4.1 HAULAGE DUST

1. Transfer Point

Haulage dust is created at points of transfer from one means of conveyance to another or from one belt to another. Dust suppression at these points has been adequately satisfied by the proper placement of water sprays and correct design of transfer points. Water sprays must be placed so as to wet the coal prior to transfer with a fog type spray which is directed to blanket the stream of coal being transferred. Basic principals of material transfer must be adhered to:

1. Height of fall during transfer should be kept at a minimum.
2. If at all possible, no change in direction of flow should be made.
3. If change in direction is required, it should be as gradual as possible to minimize size reduction of material. Baffles and angle chutes are quite helpful in this regard.
4. Speed of material at transfer point should be as low as practicable.
5. If at all possible, material should be well moistened prior to transfer points. Water should be sprayed on coal as it is transferred.

Falling coal is normally sprayed by banks of nozzles activated automatically at belt loading, transfer, and unloading points. Some operators spray coal before it is transferred or unloaded. Many operators find it necessary to keep the belt moist at all times by wetting the top side of the returning belt. Some spray it on or let a dribble of water run at all times.

Examples of proper spray application at the most common types of transfer points are shown in Figures 5-24, 5-25.

2. Belt Cleaners

The removal of wetted dust and coal from the belt return is important to prevent dust generation due to spillage. This can be accomplished in several ways. Three typical methods are shown in Figures 5-26, 5-27 and 5-28.

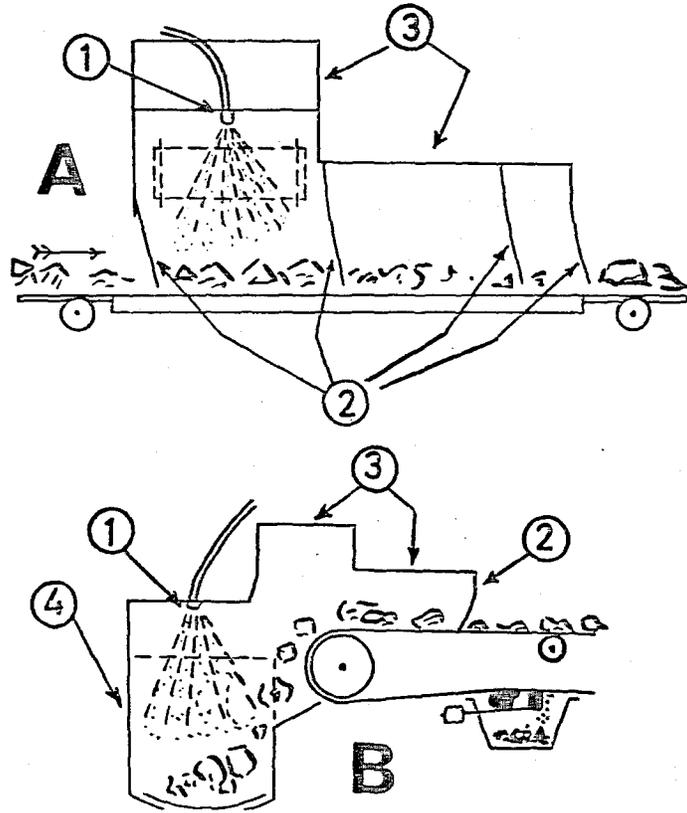


Figure 5-24 Belt Transfer Point
 A-Side Elevation, B-Cross Section
 1-Water Sprays, 2-Rubber Dust Shields
 3-Sheet Metal Covers, 4-Rubber Sheet

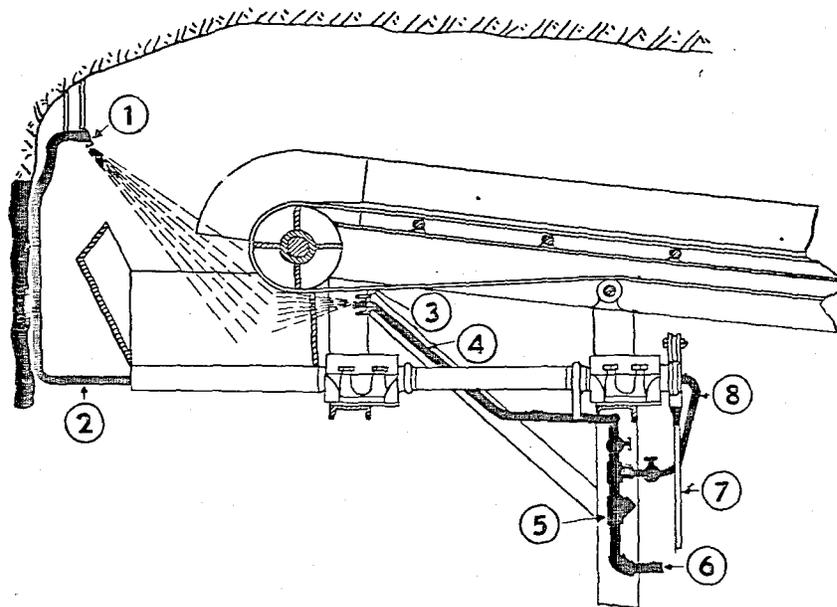


Figure 5-25 Loading Head
 1-Spray, 2-Water Line, 3-Sprays, 4-Water Line,
 5-Strainer, 6-Water Supply, 7-Control Handle,
 8-Water Line

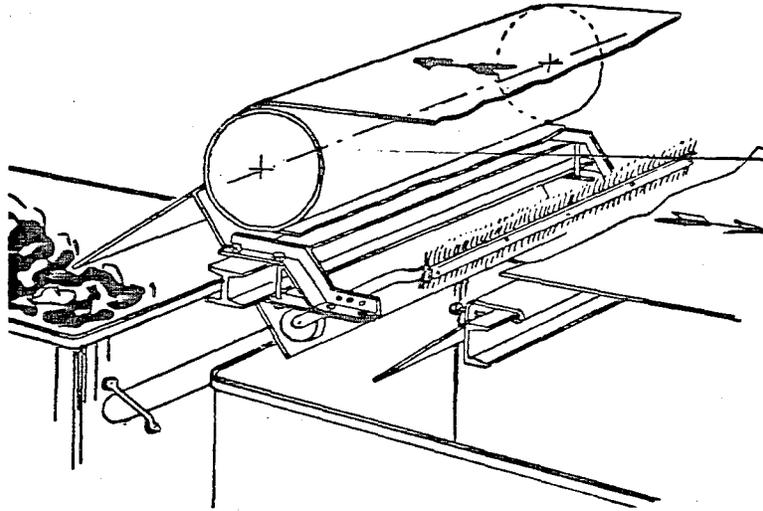


Figure 5-26 Wire Brush Cleaner

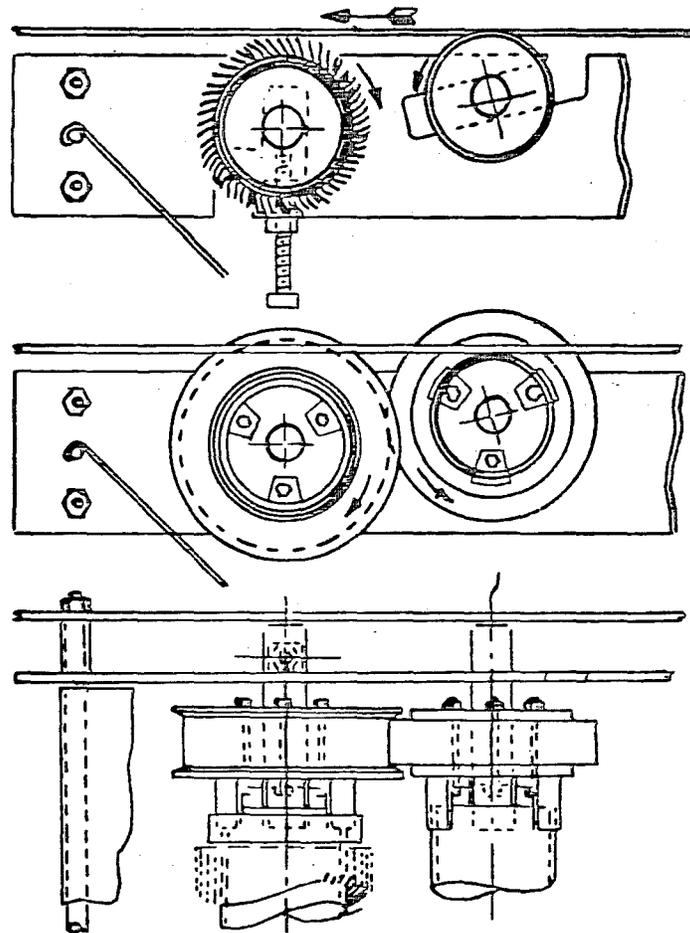


Figure 5-27 Rotating Brush

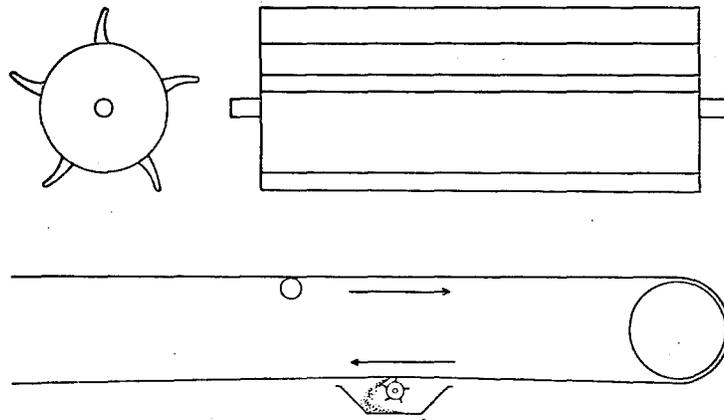


Figure 5-28 Belt Beater

3. Mine Cars

The use of mine cars presents several sources of dust. They are:

- (a) Loading
- (b) High speed haulage
- (c) Unloading or dumping

Dust created during loading and unloading can be suppressed in much the same manner as at a belt transfer point. Proper spraying of the coal prior to and during transfer will usually be satisfactory.

During haulage, the movement of air across the top of the coal will tend to evaporate moisture from that portion of the load creating a potential dust problem. This can be solved by having automatic solid cone nozzles placed strategically, on long hauls, which will turn on as the trip comes by.

5.4.2 ROOF DRILLS

The advent of roof bolting in the early fifties presented the coal mining industry with a new dust control problem. Control of roof drill dust was an undeniable necessity because of the high free silica content of the cuttings. Control of the dust by conventional wet drilling was objectionable to the industry because of driller personal discomfort and adverse wetting of roof and floor. All these problems have been solved by dry collection of the cuttings through the drill steel of either pneumatic percussion or rotary drills. Positive control of the drill dust is assured by use, in the approved manner, of Bureau of Mines approved dust collectors or approved roof drills with integral dust collecting systems. Approvals have been granted which cover all types of drilling equipment.

Only limited roof drilling should be done in a dead end or other unventilated place. The approval plate indicates that only 10 test holes can be drilled with the equipment in an unventilated area without exceeding silica dust exposure limits. As no dust collector is 100 percent efficient, some drill dust escapes into the air. The dust concentration can rise to an intolerable limit unless diluting air is provided.

Effective dry dust collection can be easily defeated by allowing the dust tray or dust bag filter to become overloaded, having leaks in the filter bag, have the vacuum pump lose its efficiency, or develop leaks in the vacuum side of the dust collecting system. When confronted with wet roof occasionally one company simply substitutes auger drill steel for the normally used hollow steel.

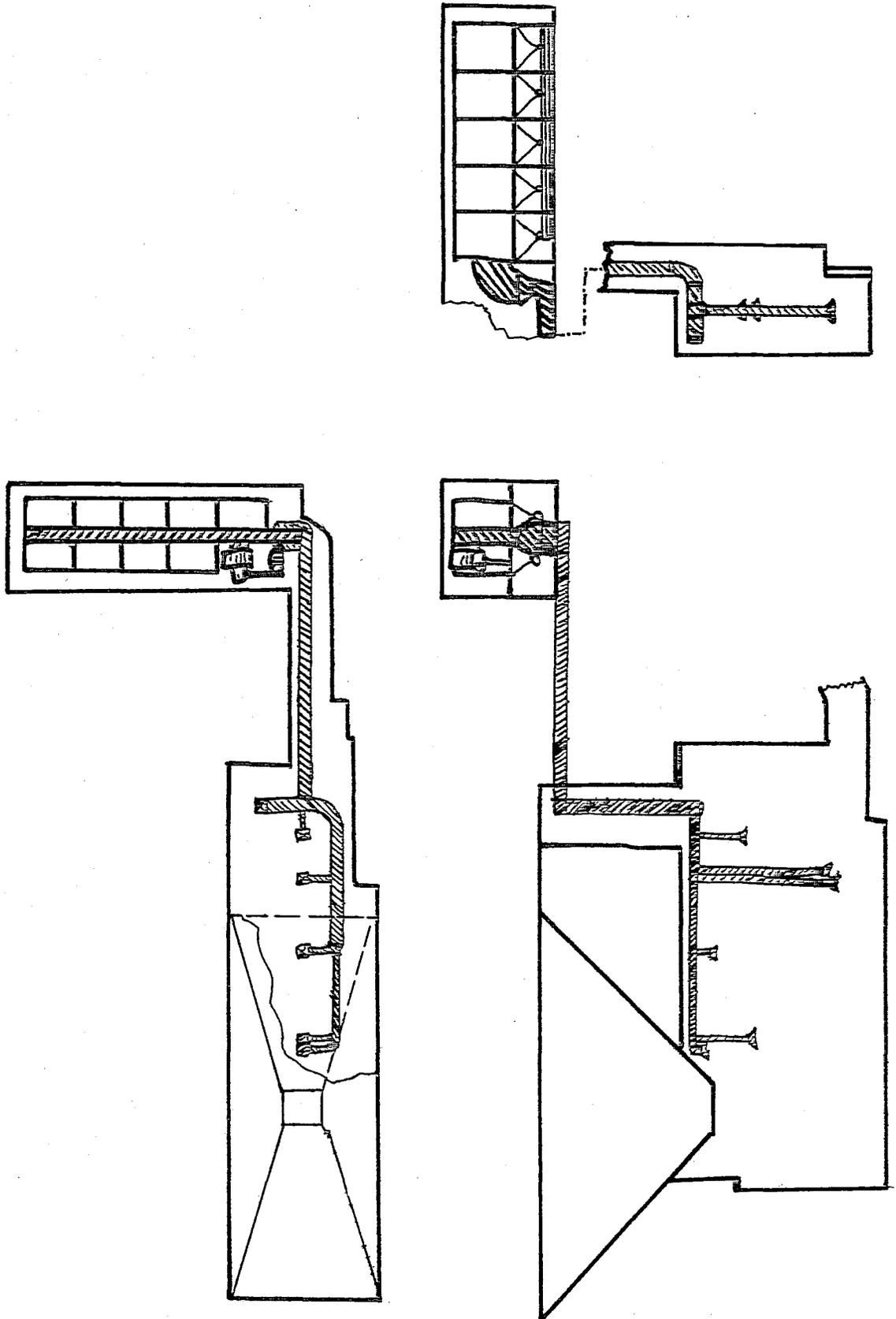
Lawfully, water can be used to control drill dust, but only if the water is introduced to the bottom of the hole through the drill steel. If the amount of water used is insufficient, about 1 gallon per minute or less, successful control cannot be attained.

5.4.3 UNDERGROUND CRUSHERS AND SCREENS

In locations where crushers and screens are utilized below ground, dust control methods similar to those used in surface preparation plants must be employed. This entails the use of an exhausting hood and duct system engineered to the specific equipment to be installed. The duct system must then convey the dust laden air to an efficient collector for dust removal and air recirculation. An alternative can be to exhaust the dust laden air to the surface for filtration. The determination of which system to be used will depend upon individual conditions at each location. In the case of underground collectors, a cloth filter must be employed to meet the requirements of dust concentrations of intake air. This requires the construction of a filtration room which will exceed in height the coal seam being mined. The walls and ceiling of such a room should be constructed of concrete or of steel beams and columns for roof support. The type of overburden will determine which is required. In addition, the room must be of sufficient size to enable the collector to be properly maintained. A typical installation is shown in Figure 5-29. Provision must be made for removal of the collected dust from the mine. The recovered dust can be briquetted or bagged or it may be deposited on the main haulage system for removal.

A cost analysis must be made of this system vs. conveying the dust laden air to the surface. First cost of a filtration room is high, but cloth filters do not have high maintenance and operating costs. The cost of installation of a duct system to the surface with sufficient velocity to keep dust in suspension can be costly and the resultant fan horsepower can become a major factor. Each situation will have a different cost analysis and this should be calculated by a competent engineer well versed in dust collection systems.

Underground Hood & Duct Collection
System for a Crusher & Screen



5-49

Figure 5-29

