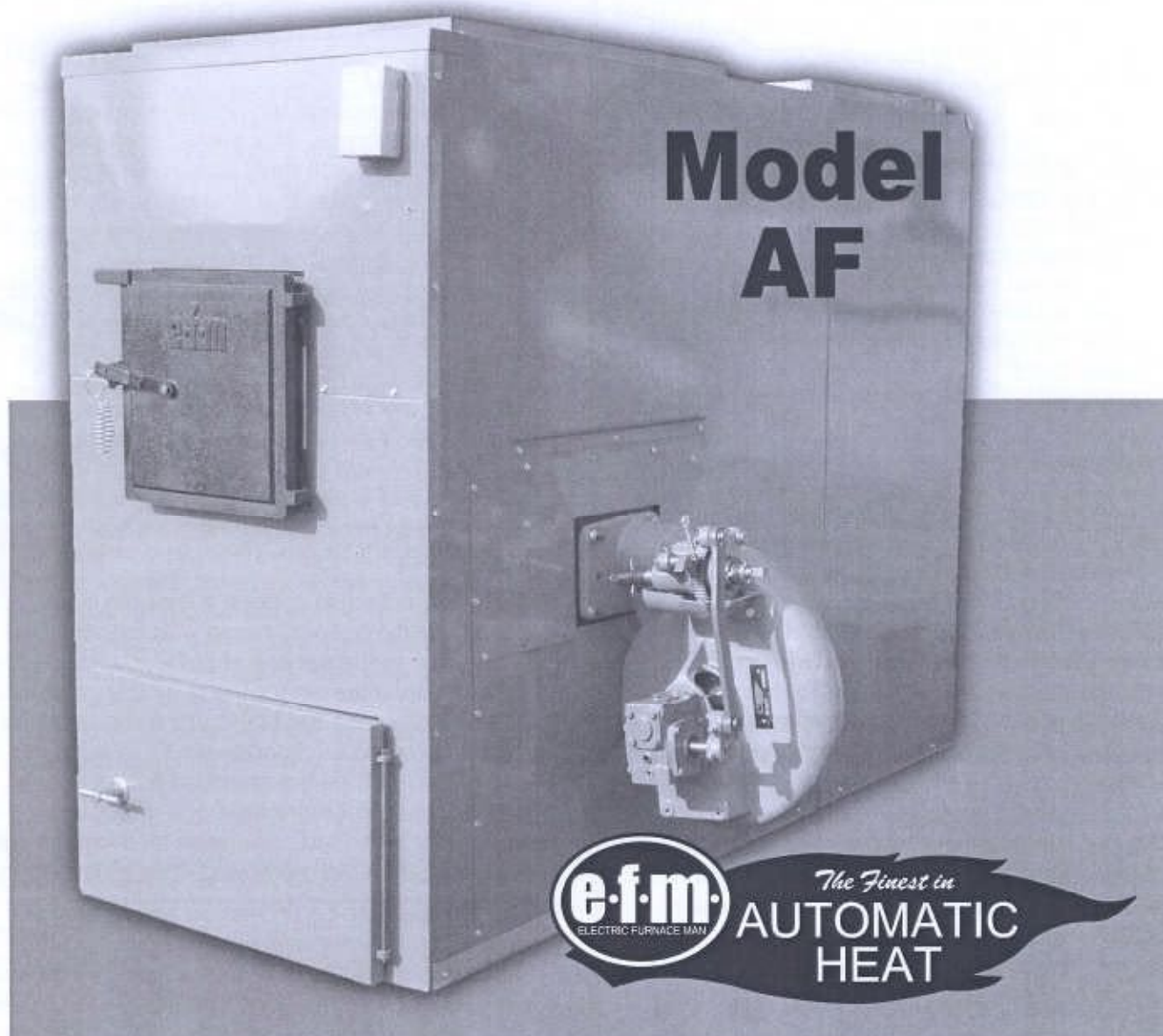


Installation and Operating Manual for the EFM Stoker Furnace Units



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Installation And Operating Instructions For Model AF Stoker Furnace Unit

This manual contains information for the installation, operation, care and service of the EFM AF Stoker Fired Furnace. Be sure to follow these instructions carefully when making the installation. **Before proceeding, the installation, be sure to check State and Local Ordinance requirements. Installation must be made in accordance with local ordinances which may differ from this installation manual.**

These instructions are to be saved and given to the equipment owner for operation and maintenance information.

The unit is subject to shipping damage during transit or can be shipped with missing parts. Upon receipt, examine all cartons and boiler for possible missing parts or damage. If unit is damaged, notify carrier immediately. If parts are missing, notify factory as soon as possible.

The AF Stoker Furnaces are shipped as follows:

1. Furnace Heat Exchanger (with baffle, fire door and ash can)
2. Front cabinet panels and base
3. Rear cabinet panels and base
4. Stoker assembly with ash pit door
5. Stoker bin feed pipes and worms
6. Stoker hood
7. Blower assembly, wiring harness, fan and limit control
8. Air filters

The Efm Model S20 Stoker as furnished with the AF Furnaces is designed for coal firing only. Use only Pennsylvania Anthracite Coal in the size known as "Rice Coal". Do not burn garbage, gasoline or naphtha. Do not use or store flammable liquids, especially gasoline in the vicinity of the furnace. Install this furnace in accordance with the applicable requirements of N.F.P.A. #211, "Chimneys, Fireplaces, Vents and Solid Fuel Burning Appliances", 1980 Edition.

Coal

1. The coal should contain not more than 10% oversize and not more than 15% undersize. Oversize or undersize in excess of these amounts will result in poor combustion.
2. Excessively wet coal should not be used, as it

contains certain chemicals or oil. The excess quantities of oil on the coal will result in unsatisfactory operation. It creates a sludge with the fines which fills the burner air inlet holes and causes poor combustion. The use of some chemicals for Dust Treatment creates a corrosive action on the stoker feed worms that shorten their life considerably.

3. When securing a supplier for your coal, be sure he is aware of the above conditions and make sure you get clean coal with no foreign materials and minimal amount of fines. If you are in doubt as to the quality of the coal from your supplier, it is advisable to purchase a small quantity and try it in your unit before filling the bin.

Coal Storage

1. An adequate storage bin will have to be provided for the coal storage. This should preferably be located indoors with easy access for a coal truck to deliver the coal with a chute through a cellar window. The storage volume required for one ton of Rice Anthracite Coal is 40 cubic feet. The angle of repose of the coal is approximately 45°. Coal will slide down a smooth surface of 20° off horizontal. It is advisable to provide a drain in the bin. Be sure the bin is well supported to withstand the side thrust load of the coal. The use of a Bin Feed Trap (see Fig. 5) is recommended. This will aid in the removal of the bin feed pipe and worm for service and will make the end of the worm accessible for removal of obstructions.
2. If it is impractical to provide a coal bin close enough to the boiler to reach with the standard bin feed, a single section of bin feed worm 4 feet long to extend the bin feed is available on special order. In this case the boiler unit will have to be raised 7" (or the bin floor lower 7") to keep the end of the bin feed the standard height above the floor line. Not more than one 4 foot section of worm may be added, otherwise an overload will be imposed on the motor and drive mechanism.
3. The bin feed can be shortened and a storage drum used to store coal over the pick up end. When doing this, be sure to maintain the original exposure of worm beyond the end of the bin feed pipe. When cutting off the worm, it is advisable to

worm to the shaft. This is to provide support for the end of the worm. As the bin feed is shortened, the risk of coal gas feed back out of the end of the bin feed pipe increases. For this reason, the bin feed should be shortened only as a last resort. In no case should the first section of worm from the burner be shortened.

Disposal of Ashes

1. Ashes should be placed in a metal container with a tight fitting lid. The closed container or ashes should be placed on a noncombustible floor or on the ground, well away from all combustible material, pending final disposal. If the ashes are disposed of by burial in the soil or otherwise locally dispersed, they should be retained in the closed container until all cinders have thoroughly cooled.

Chimney

1. The chimney must be a type suitable for solid fuel and must provide a minimum draft of .04 IN/WC (as measured with a draft gage) at the furnace flue exit to provide for proper operation of the AF Stoker-Furnace Units. The chimney should be masonry with tile lining (8" x 8" x 15 ft. high) or metal insulated, with a stainless steel internal surface such as the trade name "Metalbestos". (9" dia. inside x 15ft. high). See figures 6,7, and 8 for situations which can cause poor draft conditions in a chimney.

Ventilation

1. The area in which the heating unit is located must have an adequate supply of air for combustion. Open basements without storm windows or tight doors will generally permit adequate air infiltration. If the heating unit is located in a separate room with a tight door, ventilation must be provided to an open area within the building or to the outside. If the building is of tight construction with exhaust fans, an outside air supply that is ducted into the boiler room may be required.

To Set Up Furnace

Refer to Fig. 1

1. Make sure that foundation floor is level and equate to support unit weight (approximately 800 pounds).
2. Locate base so that: Ash pit door has ample clearance; is in a convenient location for can

removal: that bin feed pipe will be in proper position in bin. Maintain a minimum of 30 inches clearance on the front, 24 inches to the rear and sides, and 18 inches to top of furnace to any obstructions or combustible material. 65 inches minimum clearance to end of bin feed trap for worm removal. Furnace side plates and cabinet insert panels are constructed so that stoker may be installed on either side of unit. See Figure 1 for overall dimensions of furnace.

3. Refer to jacket installation manual for complete detailed assembly instructions.
Note: Do not install the jacket pieces around stoker or coal pipe until stoker and pipes are installed.

To Install Stoker

Refer to Fig. 2

1. Remove stoker fan housing assembly, burner assembly and furnace ash pit door from the shipping carton.
2. Fasten stoker fan housing assembly to stoker mounting plate. Four studs are welded to the plate for mounting. When assembling stoker to mounting plate, be sure pouch is located toward right side of plate as viewed from outside face.
3. Assemble air pipe and burner assembly to the stoker fan housing, be sure that slots in ends of air pipe engage with pins and **that air pipe is all the way in air chamber and fan housing hubs** before tightening set screws.
4. Install cleanout lever and rod. Fasten cast iron eye on end of rod to underside of burner with shoulder screw. Lever is fastened to side of fan housing with shoulder screw. Locate spring on outside of mounting plate.
5. Mount stoker assembly in position on furnace. Be sure gaskets are in place under mounting plate.
6. Loosen nuts holding furnace side plate (bin feed side). Fasten lower half of cabinet insert panel (bin feed side) to cabinet and base. Mount coal pipe collar to furnace side plate temporarily with one screw. Insert short length of coal pipe through collar and furnace side plate and into gooseneck. Be sure pipe is against shoulder in gooseneck. The beveled inside edge of coal pipe must be toward coal bin. The vent holes in pipe must be on top. Slot engages pin in gooseneck. Tighten set screws. After stoker, air pipe and coal pipe are aligned, tighten nuts on furnace side plate. Remove screw holding pipe collar,

wrap packing around pipe at furnace. Fasten pipe collar, over packing, to furnace with screws and flat washers.

7. Insert coal worm, with long shaft extension, into pipe and connect with coupling to clutch shaft with cotter pin.
8. Slide cast iron coal pipe coupling over coal pipe that is in place. Assemble second section of worm with bin pipe in position over it. Coal worm coupling has left hand thread. Slide pipe coupling down over coal worm coupling. With the coal pipe ends butted together, center coupling over the joint and tighten four set screws to hold coal pipes in position. See Figure 3. Apply boiler putty to the ends of the coal pipe coupling to prevent leakage of coal dust and fines.
9. Install jacket pieces round coal pipe.
10. Fasten cabinet insert panels (stoker side) to cabinet and base. Fasten bottom insert panel in position first. When assembling top insert panel, be sure offset strip (on back side) engages top of stoker mounting flange to securely lock panel in position and prevent air leaks. Place stoker hood mounting strip in position along top edge of insert panel prior to securing in place with sheet metal screws.
11. Place ash can inside base of furnace and bolt ash pit door in place.

Flue Pipe Installation

1. A barometric draft control is supplied with this furnace, the use of one is highly recommended to assure uniform draft operating conditions. See Figure 2 for proper location.
2. The flue pipe connection to chimney can be completed with either smoke outlet opening on furnace, located on both sides of furnace close to the floor. Opening not used for flue connection is to be covered with plate provided. This serves as a cleanout opening. Install cleanout cover on upper opening on left side. The flue pipe must be 8" nominal dia. galvanized steel. (24 Ga. minimum thickness). The flue pipe should be short as possible (while maintaining recommended clearances), with a minimum of elbows and must pitch upward to the chimney connection. Maintain 18 inches clearance (minimum) between stack and combustible material. Secure each flue pipe joint and furnace flue outlet connection with sheet metal screws. See Figure 2.

Electric Installation

1. All wiring must be in accordance with local codes or in absence of a local code must comply with the National Electric Code.
2. Refer to appropriate wiring diagram Figure 5 when wiring the installation.
3. Provide a disconnect switch in the circuit supplying the stoker. The EFM Model S20 Stoker operates on 1210 VAC 60 Hz with power draw of 2.5 amps. The furnace blower motors operate on 120VAC 60 Hz. The AF blower motor (1 HP) power draw is 11 amps or less.
4. The stoker timer-relay is to be mounted in close vicinity of the furnace. In mounting the timer, keep in mind that this timer has internal relay which will cause an audible thump, when energized, which will carry through the house if mounted on a ceiling joist, furnace cabinet or similar surface.
5. Knockout holes are provided in each rear side cabinet panel to bring wiring into the blower compartment.
6. The fan and limit control mounts on the top-front right hand corner of the furnace. Holes are provided in the top front panel for mounting.
7. Use 12 Ga. copper wire for all wiring except thermostat wires. Route all wiring to avoid hot surfaces. Be sure the furnace (including blower assembly) is well grounded electrically.
8. Locate the thermostat where it will sense the natural air circulation within the building. Do not place it in a location where it will be subject to cold drafts from doors or windows or where it can sense the heat from radiation. It is not recommended that thermostat be installed on an outside wall, in front of a fireplace, above a lamp or at the base of an open stairwell.

Control Settings

1. The Stoker timer-relay is normally adjusted for 2½ minutes operation every hour. This setting may have to be varied to suit the draft conditions, type of coal being used or the time of year. The timer can be set for "Hold Fire" stoker operation, each half hour or hour with an adjustable time "on" period.
2. The fan and limit control has 3 settings: "High Limit", "Fan On", and "Fan Off". The High Limit setting is factory set at 200°F and should not be changed. The "Fan On" setting is normally set at 120°F and the "Fan Off" setting at 90°F. These

two settings may have to be varied slightly to suit installation conditions or customer preference.

Stoker Operation

Before Start Up

1. The reducing unit has been filled with oil at the factory. It is advisable to verify this fact by removing the oil fill plug (on top of reducing unit housing) and check oil level by inserting a dip stick and withdrawing to check oil level. When filling or adding oil, use a light gear oil. Oil is available from the factory in quart cans. Normal oil level is to the top of the output shaft.
2. Fill the ratchet oil reservoir with the oil furnished with the unit. Keep oil level approximately $\frac{3}{8}$ " above bottom of ratchet gear.
3. Oil cups on stoker motor, oil both ends of connecting rod, oil both pawls and bearing bracket with machine oil.

Starting the Fire

1. Fit the manual coal worm crank (furnished with the unit) over the end of the worm drive shaft. Turn the shaft counter clockwise until the coal covers 1" of air holes at bottom of burner plates.
2. When starting the stoker for the first time, set the feed rate at 3 teeth and the air shutter at $3\frac{1}{4}$. If the stoker is being rekindled, do not change the settings as they are adjusted already for the feed rate and coal being used.
3. Wrap a handful of wood shaving or a suitable substitute, in a sheet of newspaper and place it on top of coal. Ignite paper and start stoker.
4. After wood is ignited, place a small shovel of coal on the fire. When the coal is glowing red, add an additional layer of coal. Operation of the stoker should then be continued under control of the thermostat.

Adjusting Coal Feed Rate

1. The coal feed rate determines the output of the furnace. This data is shown on Table 1.
WARNING Do not set coal feed adjustment above 7 teeth.
2. The coal feed rate is adjusted by changing the number of teeth on the ratchet drum that the drive pawl engages with each stroke. To decrease the feed rate, loosen the thumbscrew on the set collar and rotate the collar to the left. To increase the feed rate, rotate the collar to the

right. Be sure the drive pawl engages the root of the ratchet drum tooth when the pawl falls off the pawl guide plate. Refer to Table 1 for feed rate required to achieve desired output.

3. The check pawl of the drive mechanism (mounted on an eccentric stud) must be adjusted to minimize backlash (tendency for the worm to rotate backwards on the return stroke of the drive pawl). To adjust, loosen the locking nut and rotate the stud until the check pawl falls into the ratchet drum tooth just before the drive pawl finishes its drive stroke. Tighten the locking nut.
4. It is somewhat difficult to check the actual number of teeth feed with the stoker running because of the speed at which the drive pawl engages to ratchet drum. This can be checked by manually turning the motor shaft coupling counter clockwise while counting the number of "clicks" as the ratchet drum teeth pass under the check pawl.
Disconnect power to stoker when doing this check.

Adjusting Air Supply

1. Whenever the coal feed rate is adjusted, the air setting must be adjusted also. Refer to Table 2 for air setting for each feed rate. These are approximate settings and may have to be varied to suit the particular type of coal being used. The numbers on the air indicator plate are not intended to coincide with the number of teeth being used.
2. To adjust the air setting, loosen the thumbscrew securing the indicator, make the appropriate adjustment then tighten the thumbscrew. It may be necessary to adjust the air supply several times until the desired setting is attained.
3. **With a properly adjusted fire, there will be an ash ring approximately 2" wide around the outside of the burner with a small circle of coal at the center of the fire.** With too much air, the fire bed will tend to develop cracks, the ashes will clinker and the dark spot at the center of the fire will disappear. With too little air, the ash ring will be very small, hot coals will drop off the burner ring into the ash pit and the dark spot at the center of the fire will be large.
4. Some unburned coal in the ash is normal and indicates a well adjusted fire for maximum efficiency. This amount must be small. Excess unburned coal indicates poor air-feed adjustment or a poor grade of coal. In some cases what appears as unburned coal may be slate or other foreign material.

Draft

1. All drafts should be measured with the stoker in operation and with stack at normal operating temperature.
2. A good draft is essential for proper operation of the stoker. This draft is created by the chimney when it reaches operating temperature. The draft should be checked with a draft gauge at the stack (drill 1/4" dia. hole in stack at a point within 12" of the boiler base outlet and before the barometric draft control) and through the 1/4" dia. hole in the fire inspection door (overfire draft). The over fire draft should be .02 inches water column. The stack draft should be adjusted with the barometric draft control to secure the over fire draft required.
3. Too much draft will draw heat up the chimney causing wasted heat. Too little draft can cause positive pressure in the boiler firebox with resultant "coal gas" odors in the boiler room.

Operational Checkout

1. Check furnace blower adjustment. This furnace is supplied with a variable speed direct drive blower motor. The blower speed is normally on low speed but may have to be adjusted to deliver an air temperature rise of approximately 75° between the return and supply plenums.
2. Check fan and limit control. After the furnace has been in operation for at least 15 minutes, restrict the return air supply and allow furnace to shut down on high limit. The blower motor must continue to run. Remove the restriction and the stoker should come on in a few minutes.

Before Leaving Installation

1. Before leaving installation, instruct the equipment owner on the proper operation and simple maintenance of the unit, such as: coal fed and air regulations, replacing the shear pin and removal of obstructions on the coal pickup, use of cleanout lever, how to build a fire, where and when to lubricate, use of coal worm crank. A properly informed user will eliminate some service calls.
2. Explain the information in the instruction card to the user and post close to the furnace.

To Clean Furnace

1. Keep flue passages and smoke pipe clean. This

must be done at least once each heating season or more often depending upon the amount and type of fuel used.

2. The primary section of furnace can be cleaned through the inspection door. Brush fly ash from all surfaces down into the ash pit. The radiator section of the furnace is cleaned through the two cleanout openings plus the smokepipe connection on the side of the furnace. Brush top section of radiator and tubes through the top cleanout openings. Brush out lower section and vacuum out through the lower openings. When replacing the cleanout covers, be sure gaskets are in good condition and gas tight.

Fines Cleanout

1. To prevent fines accumulation in the burner air chamber and costly repairs, the cleanout lever must be pulled back and held in that position (with stoker operating) for 15 seconds once every day. Be sure to return the lever to its original position by pushing in toward boiler, using force to be sure cleanout is closed.

Furnace Operation

1. Examine air filters at rear of furnace twice each heating season and replace if not reasonably clean. The filter size is 16" x 25" x 1".
2. When the furnace is not in use, as during the summer, the ash pit door and fire door should be left open to circulate air through the furnace to remove dampness and prevent corrosion.
3. A manual switch can be added to provide continuous blower operation during summer when recirculation of the room air is desired. The upper rear cabinet panel can be removed to circulate basement air through the house in the summer with continuous blower operation.

Ashes

1. Remove ashes as necessary to prevent overflow of ash into furnace base.

Outfires

1. A stoker fired furnace is different than an oil, gas or electric unit in that the fire must be maintained by periodic running of the stoker even though there is no call for heat by the thermostat or operating aquastat. This is accomplished by the timer. A normal setting on the timer is 2 1/2 minutes of stoker operation per hour. This is a suggested

start and may have to be varied to suit installation conditions, coal being used and time of the year.

2. An outfire on the stoker is a more prevalent condition during warmer months. It can happen even though you find nothing wrong on the stoker mechanism. Following are some conditions which can cause an outfire. These are situations that start to develop where there is no apparent explanation. For other situations refer to service check list.
 - A. Loss of draft. This occurs during warm weather with a low fire in the burner. Changing time operations from one per hour to every half hour and slightly increase feed rate and more combustion air will help. Thoroughly cleaning furnace, flue pipe and chimney will also help (to remove fly ash buildup). Be sure ash pit door and firedoor are closed tightly. Be sure cleanout handle is in closed position (push toward furnace).
 - B. Too much draft. This is most apt to occur during cold windy weather where there is no barometric draft control in the stack. In this situation the fire continues to burn even though the stoker is not running. Addition of a barometric control, or proper adjustment (if one is present) will help. Exhaust fans can also cause this problem by drawing air down the chimney, through the burner and out the fan housing inlet. This can be corrected by providing adequate outside air intake openings for both the stoker and the exhaust fan or discontinue use of the exhaust fan.

Service Check List Stoker Operation

No Heat

Stoker will Not Run (See Below)
Outfire (See Below)
Pin Sheared (See Below)
Not Feeding Coal (See Below)
Blower Motor Failure
Blower Loose From Motor Shaft Failure
Control Failure

Not Enough Heat

Thermostat Improperly Located
Thermostat Set Too Low
Furnace Too Small For Job
Limit Control Set Too Low
Too Little Coal Feed
Insufficient Combustion Air
Furnace And Flue Passages Dirty
Air Chamber Filled With Fines
Burner Plate Holes Clogged
Poor Air Admission in Boiler Room
Poor Grade of Coal
Inadequate Duct Sizes
Blower Loose From Motor Shaft

Too Much Heat

Thermostat Set Too High
Thermostat Improperly Located
Control Failure
Control Circuit Shorted

Not Feeding Coal (Stoker Running)

No Coal Over Bin Worm Pick-Up
Wet Coal, Packed, Arching Over Worm Pick-Up
Feed Pawl Disengaged
Check Pawl Disengaged
Pin Sheared (See Below)
Coarse Coal Riding on Worm Pick-Up
Bin Worm Disengaged

Pin Sheared

Obstruction In Worm Or Worn Worm
Poor Grade Of Coal
Packing Of Fines

Outfire (See Outfire Section In Instructions)

Timer Operates Too Infrequently
Timer "ON" Operation Too Short
Excessive Draft
Too Little Draft
Too Much Combustion Air
Not Feeding Coal (See Above)
Stoker Will Not Run (See Below)

Exhaust Fan In Building
Control Failure
Too Little Coal Feed
Air Chamber Filled With Fines
Burner Holes Clogged
Insufficient Combustion Air

Stoker Will Not Run

No Power Supply
Fuse Blown
Motor Failure
Switch Off
Control Failure

Stoker Noisy

Check And Drive Pawls Not Adjusted Properly
Loose Or Bent Fan
Motor Needs Oil
Reducing Unit Needs Oil
Oversize Coal
Loose Fan Blade
Fan Rubbing Housing
Coupling Slipping Or Out of Alignment
Crank And Connecting Rod Not Adjusted
Oil Low In Oil Reservoir

Too Much Fly Ash

Excessive Combustion Air
Excessive Draft
Excessive Fines In Coal

Poor Draft

Chimney Too Low (See Fig. 6 and 7)
Chimney Too Small
Chimney or Flue Pipe Obstructed
Furnace Passages or Flue Pipe Full of Fly Ash
Excessive Air Leaks Into Furnace
Base of Chimney Full of Fly Ash Where Flue Pipe Enters

Coal Gas Smell

Poor Draft (See Above)
Excessive Combustion Air
Firedoor Not Closed Tightly
Exhaust Fan Running

Excessive Coal Consumption

Boiler Needs Cleaning
Building Temperature Too High
Thermostat Improperly Located
Too Low Coal Feed
Poor Grade of Coal
Poor Combustion
Excessive Air Leaks into Boiler
Too Much Combustion Air
Faulty Distribution System
High Stack Temperature

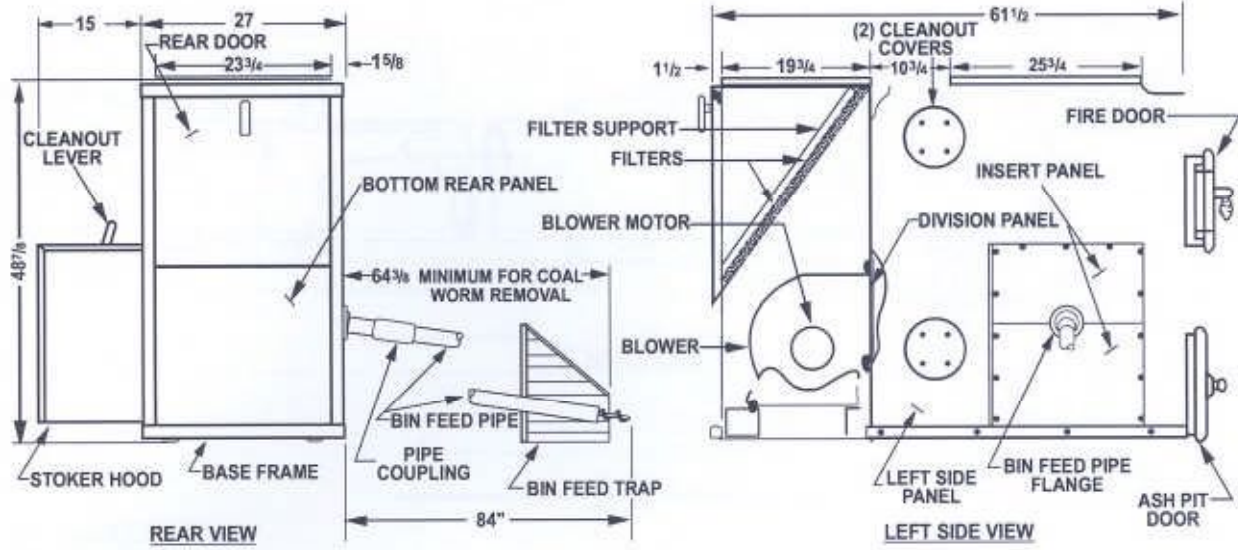


FIGURE 1

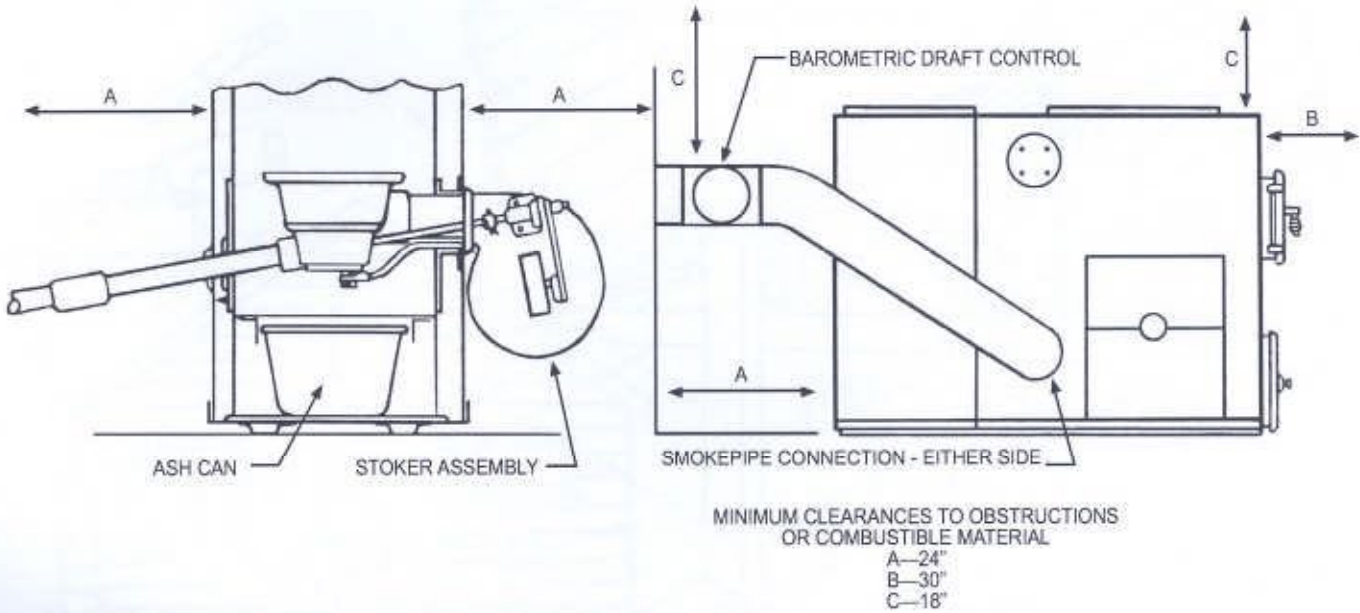


FIGURE 2

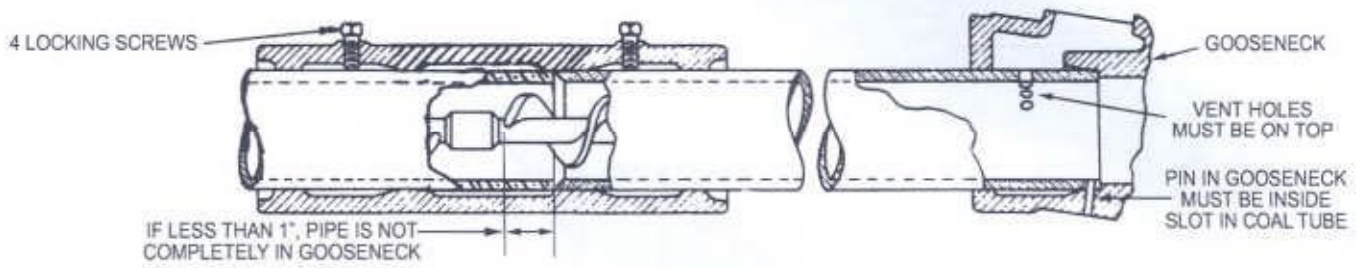


FIGURE 3

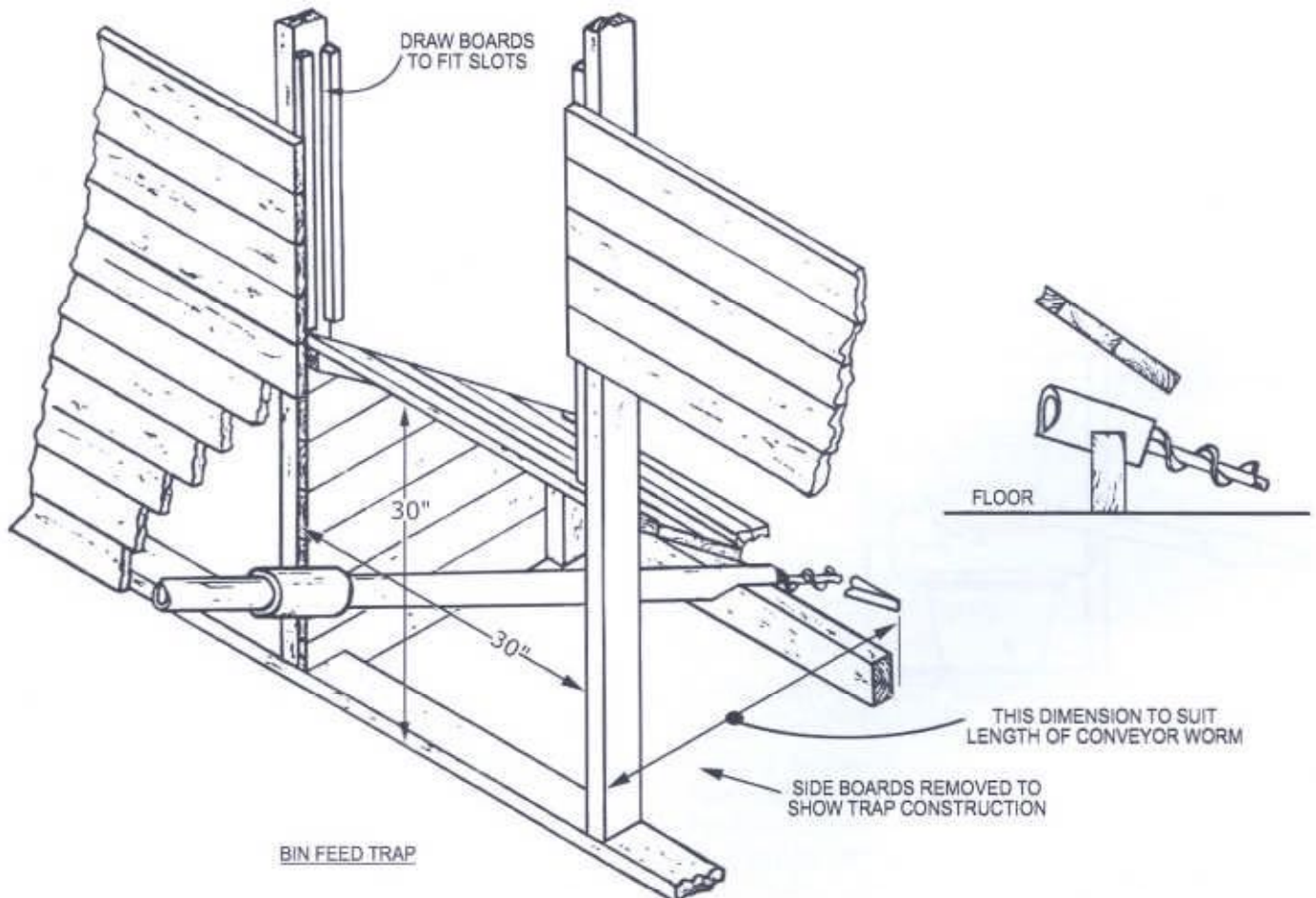
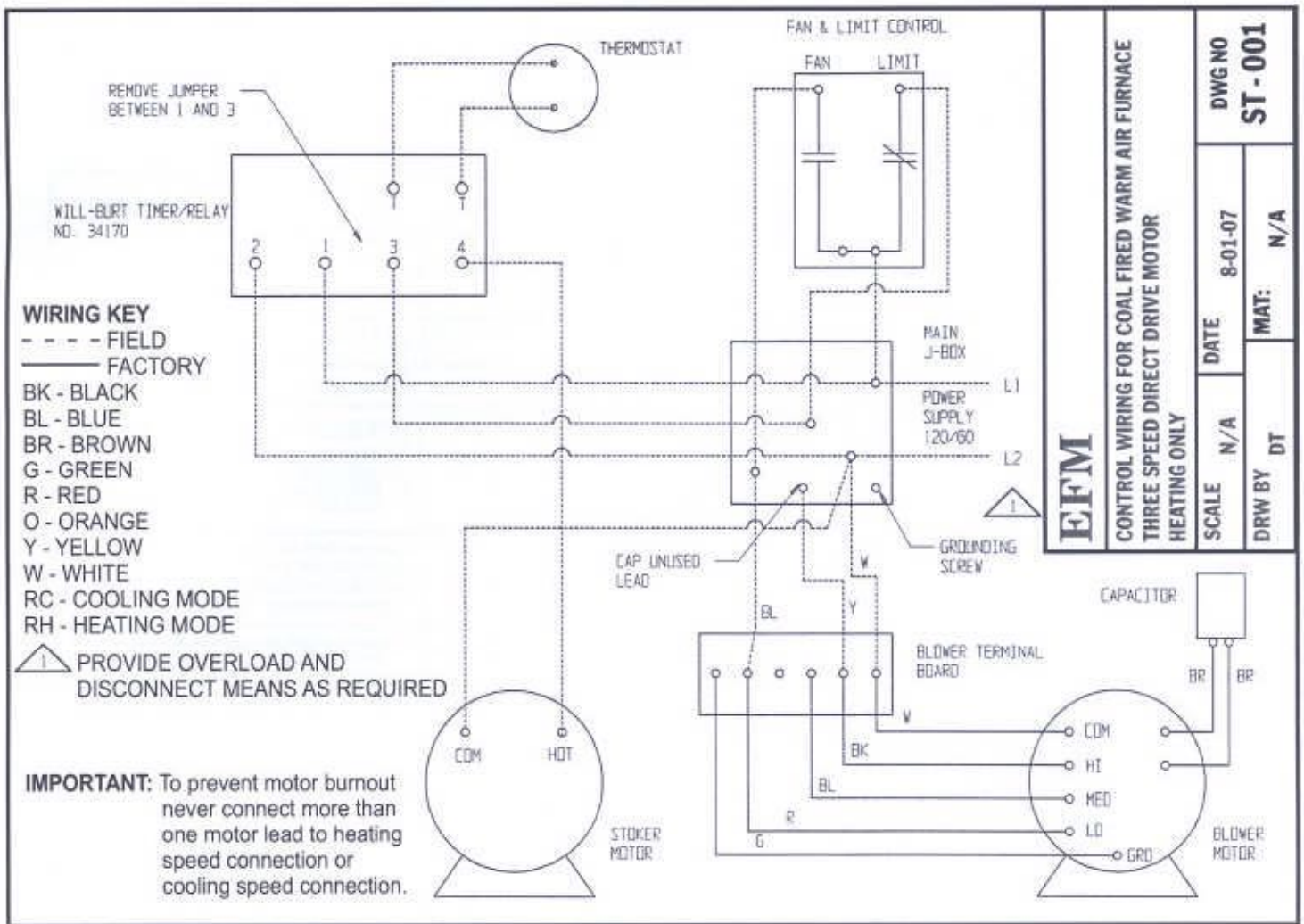


FIGURE 4



WIRING DIAGRAM FIGURE 5

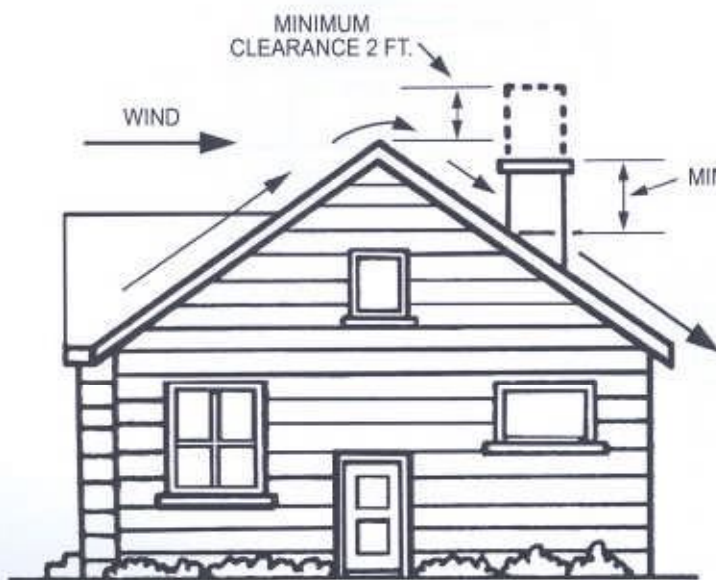


Fig. 6

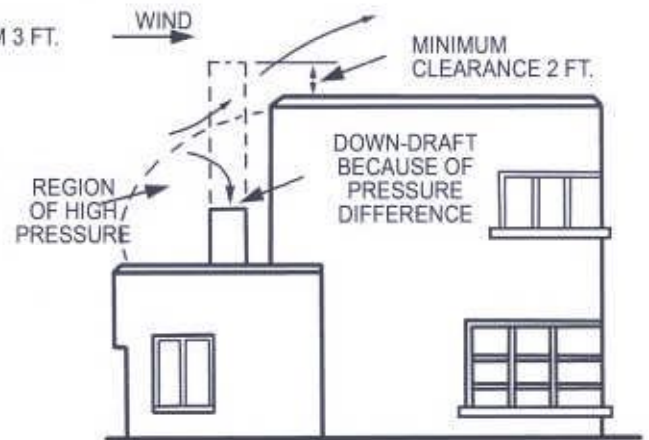
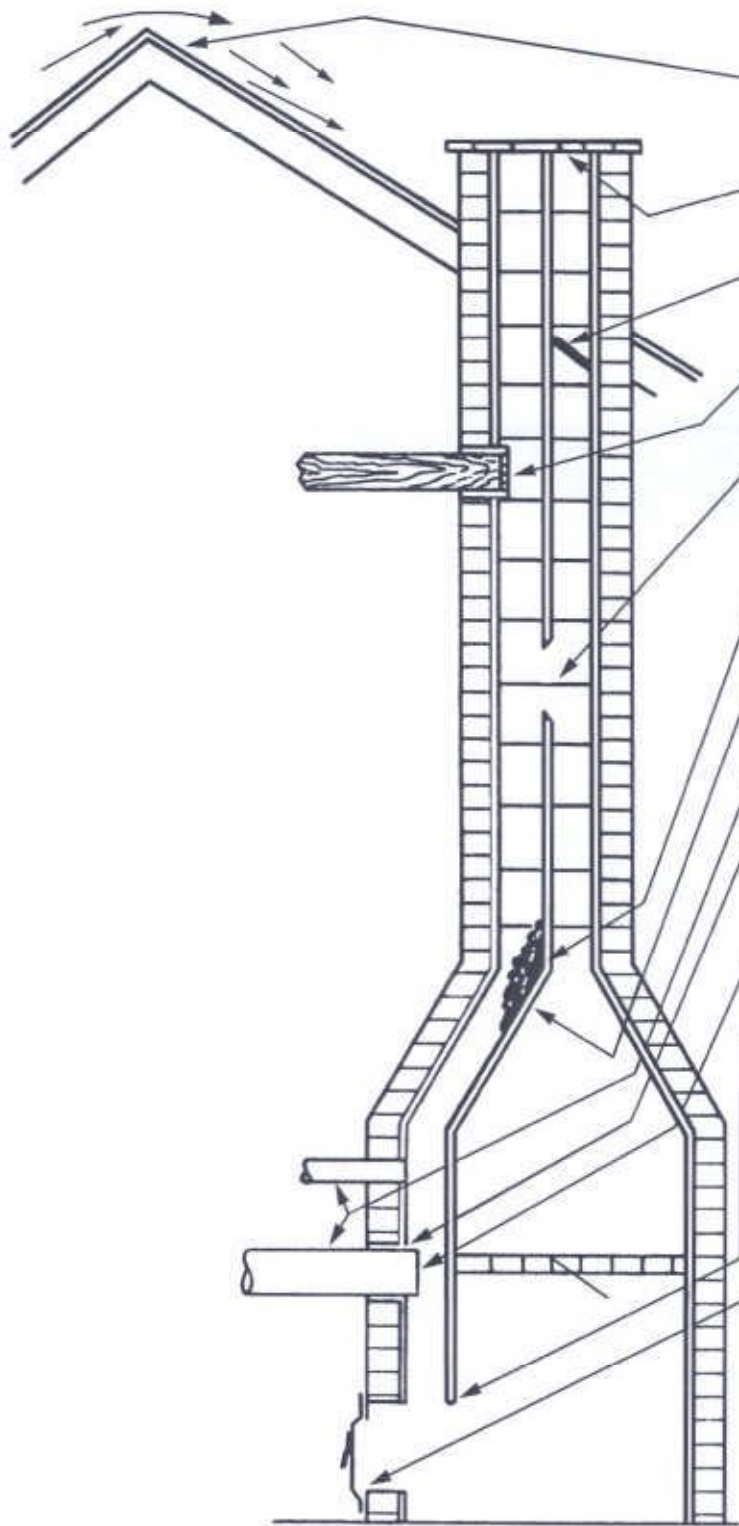


Fig. 7

COMMON CHIMNEY TROUBLES AND THEIR CORRECTION



Troubles	Examination	Corrections
Top of chimney lower than surrounding objects	Observation	Extend chimney above all objects within 30 feet
Coping restricts opening	Observation	Make opening as large as inside of chimney
Obstruction in chimney	Can be found by light and mirror reflecting conditions in chimney	Use weight to break and dislodge
Joint projecting into chimney	Lowering a light on extension cord	Must be handled by a competent brick contractor
Break in chimney lining	Smoke test-build smudge fire blocking off other opening, watching for smoke to escape	Must be handled by a competent brick contractor
Collection of soot at narrow space in flue opening	Lowering a light on extension cord	Clean out with weighted brush or bag of loose gravel on end of line
Offset	Lowering a light on extension cord	Change to straight or to long offset
Two or more openings into same chimney	Found by inspection from basement	The least important opening must be closed, using some other chimney flue
Loose fitted pipe in flue opening	Smoke test	Leaks should be eliminated by cementing all pipe openings
Smoke pipe extends into chimney	Measurement of pipe from within or observation of pipe by means of lowered light	Length of pipe must be reduced to allow end of pipe to be flush with inside of tile
Failure to extend the length of flue partition down to floor	By inspection or smoke test	Extend partition to floor level
Loose fitted cleanout door	Smoke test	Close all leaks with cement

Fig. 8

AF SPECIFICATIONS FOR HEATING

TEETH FEED	POUNDS COAL/HR.	BONNET OUTPUT BTUH	LOW SPEED BLOWER CFM	BLOWER SIZE	STOKER MOTOR HP	BLOWER MOTOR HP	FILTER SIZE (2)	SMOKE PIPE OUTLET	CHIMNEY SIZE
4	10	100,000	1800	11 x 10	1/8	1	16 x 25 x 1	8	8" x 8" x 15'
5	12½	120,000							
6	15	135,000							
7	17½	150,000							

TABLE 1

Note: 4 teeth of feed may result in too low of a temperature rise in the plenums and may have to be increased to achieve the proper temperature.

APPROXIMATE AIR SETTING FOR STOKER				
Coal Feed Teeth	4	5	6	7
Points on Air Indicator	4	4½	5¼	6

TABLE 2