CANADA

DEPARTMENT OF ENERGY, MINES AND RESOURCES

OTTAWA

MINES BRANCH INVESTIGATION REPORT IR 68-55

A COAL-FIRED PILOT LIGHT FOR STOKERS

by

B.C. POST, W.D. SHAW AND F.D. FRIEDRICH

FUELS RESEARCH CENTRE

COPY NO. 1

SEPTEMBER 10, 1968

A COAL-FIRED PILOT LIGHT FOR STOKERS[1/]

by

B.C. Post[*], W.D. Shaw[**] and F.D. Friedrich[***]

Introduction

When used to heat buildings, coal stokers have difficulty in maintaining ignition of the fuel bed during long periods in which there is no demand for heat, as frequently happens in the spring and fall. This was found to be the case by the Bituminous Coal Institute of Canada (BCI) with the Will-Burt stoker that otherwise has a number of interesting design features.

The Technical Committee of BCI considered a number of ways of improving the stoker's hold-fire performance and decided that it might be worthwhile to develop, if possible, a model of a coal-fired igniter that would permit automatic re-ignition of a stoker fire. This task was given to the Canadian Combustion Research Laboratory (CCRL) as part of a model-stoker research project supported by a Dominion Coal Board research grant-in-aid.

Pilot Light Main Features

It was proposed that the pilot light take the form of a separate but small stoker, operating continuously with less than stoichiometric combustion air to produce hot burning coals as a source of ignition for the main firebed. The throughput chosen for the first development model was 20 to 40 lb of coal/hr, which is not enough to generate steam in a 150 hp boiler.

[1/] A project sponsored by Bituminous Coal Institute of Canada and supported by the Dominion Coal Board grant-in-aid.

[*] Research Technician, [**] Technical Officer, and [***] Senior Scientific Officer, Canadian Combustion Research Laboratory, Fuels Research Centre, Mines Branch, Department of Energy, Mines and Resources, Ottawa, Canada.

The boiler selected for field evaluation of the pilot light was a Spencer low-pressure, water-cooled, firebox boiler which offered only one access to the main firebed through a large, furnace inspection door on the right side near the front. This necessitated locating the pilot light outside the boiler, and providing it with its own furnace and sealing it to the boiler access door. With this arrangement the stoker discharge needed a chute to carry the burning coals through the access door to the main firebed.

The design of the pilot light was based on a small vibrating-grate stoker previously developed at the Canadian Combustion Research Laboratory (1). The dimensions of the grate and windbox section were 18 in. long x 12 in. wide x 5 in. deep. The grate sides were made of Inconel, and extended 4 in. above the grates to contain the firebed, as shown in Figure 1. This section was mounted on four flexure plates of cold-rolled steel 9 in. x 1 1/2 in. x 1/8 in. These, in turn, were mounted with suitable brackets to an angle-iron base reducing the free length of the flexure plates to 6 in. The vibrating force was supplied by a single-phase vibrator driven by an electric motor controlled through an automatic timer.

The above assembly was mounted on a suitable angle-iron frame to raise the stoker discharge to the level of the boiler access door. This framework also supported the furnace of the pilot light which consisted of castable refractory sections, in steel frames, bolted together as shown in Figure 2. The combustion-air fan and motor were located inside the supporting framework, with a flexible hose connecting the discharge of the combustion-air fan to the windbox. Air flow was controlled by a tight-fitting damper at the fan inlet.

The coal hopper was mounted immediately over the first section of the vibrating grate through a flexible seal arrangement. Gravity coal feed was assisted by the grate vibration so that the rate of feed was controllable to a limited extent by adjusting the duration of the vibrator "on" cycle. Feed rates of coal were controlled by an adjustable gate at the bottom of the coal hopper.

The grate consisted of three bars 6 in. x 12 in. mounted over a common windbox. The grate bars were designed with air-cooled fins and were cast in a heat-resistant gray-iron alloy. A stainless steel discharge chute fastened to the end of the grate completed the grate assembly.

A successful automatic control system for this application is shown in Figure 3. It is a standard dual timer that controls both the length of time and the frequency of the "on" cycle of the vibrator.

Laboratory Tests of the Development Model

The development model of the pilot light was installed on a locomotive-type boiler in the CCRL. Numerous tests were made to calibrate the air flow and coal-feed rates for field service in the Spencer boiler mentioned above.

It should be stated that on the basis of previous experience with vibrating grates no attempt was made either to record grate temperatures or to measure the pilot-light efficiency.

To avoid complete combustion of the coal on the grate the air openings in the grate bars were adjusted by trial and error. The best results were achieved with a dead plate (no air openings) replacing the first grate bar and a 9-in. square of active combustion area centered in the second and third grate bars. This area had about 3% air opening.

Early tests demonstrated that an ash retarder was needed to avoid vibrating the fire completely off the grate. However, when a shallow vertical retarder proved to be too much of an obstruction, a curved retarder was incorporated in the design of the stainless steel chute which carried the burning coal onto the firebed of the main stoker. The retarder and discharge chute are illustrated in Figure 1.

The first tests were carried out with flexure plates made of cold-rolled steel designed as described in Reference (1) and having dimensions of 9 in. x 1 1/2 in. x 1/4 in. They gave a natural frequency of 900 cycles/min which resulted in good agitation of the fuel bed but the amplitude was too low to give the high flow rate of the firebed required for this special application. Thinner flexure plates of the same material were then designed having the dimensions of 9 in. x 1 1/2 in. x 3/16 in. The flow rate was increased but not enough.

Finally, flexure plates with dimensions of 9 in. x 1 1/2 in. x 1/8 in. were installed. These reduced the natural frequency to about 400 cycles/min, which made it possible to maintain a satisfactory rate of discharge of burning coal with the timer set for a vibrator "on" period of 5 sec every 10 min.

Field Installation

Following the laboratory tests and calibration, the pilot light was installed on the Spencer boiler mentioned earlier which serves greenhouses in the Toronto area. The tests were carried out by BCI who reported that the pilot light was proven to be technically feasible.

Acknowledgments

Special thanks are due to Mr. J. M. Mott, General Manager, BCI of Canada, for suggesting the pilot-light development and to the BCI Technical Committee for their support of the work described in this report.

Thanks are also due to the Dominion Coal Board for a research grant-in-aid that made this investigation possible.

Reference

(1) F. D. Friedrich, "Development of a Model Vibrating-grate Stoker for Strongly Caking Coals", J. Inst. Fuel, March 1965.

o o o

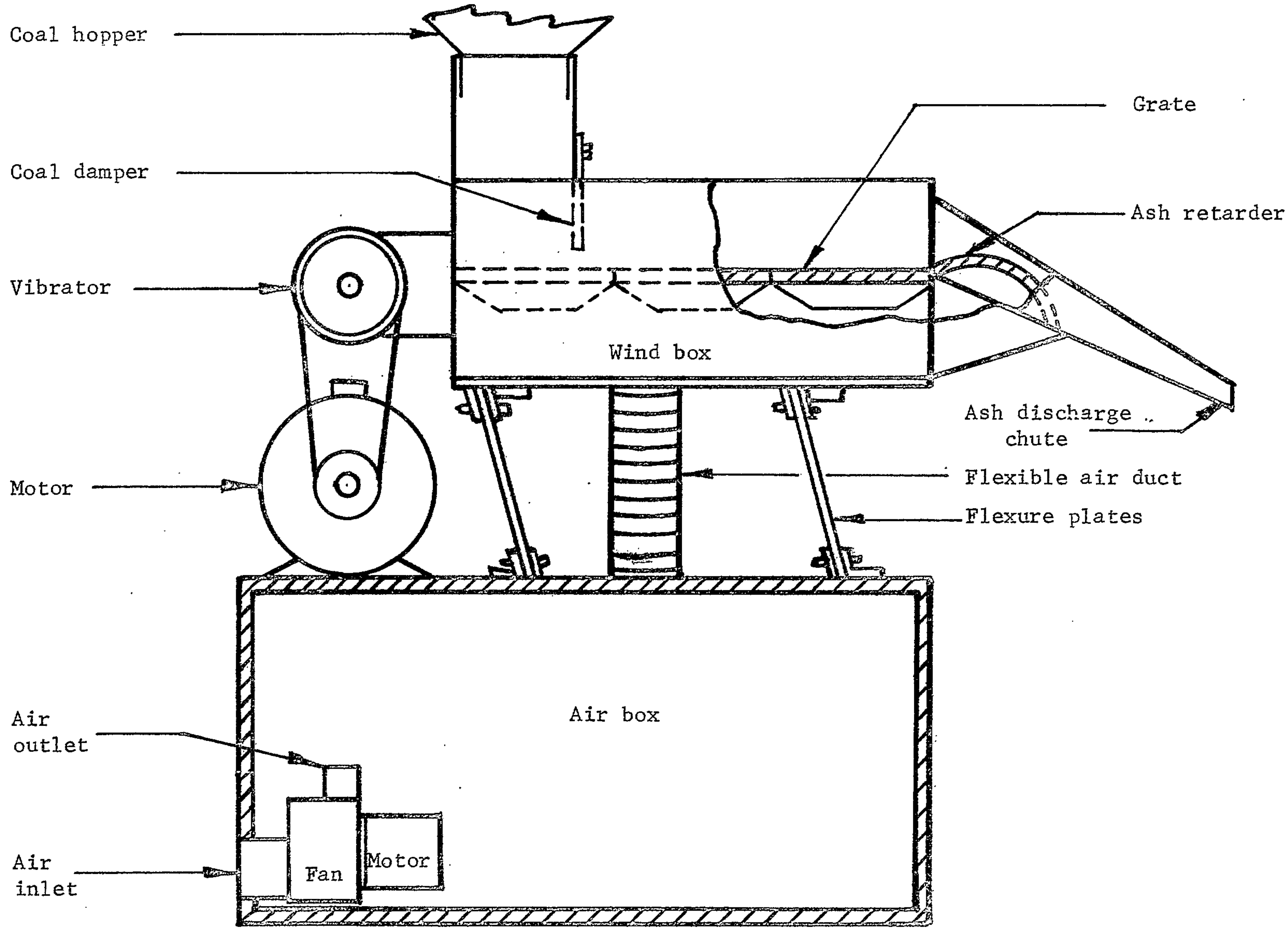

Figure 1. Cross-sectional illustration of grate and air-box sections.

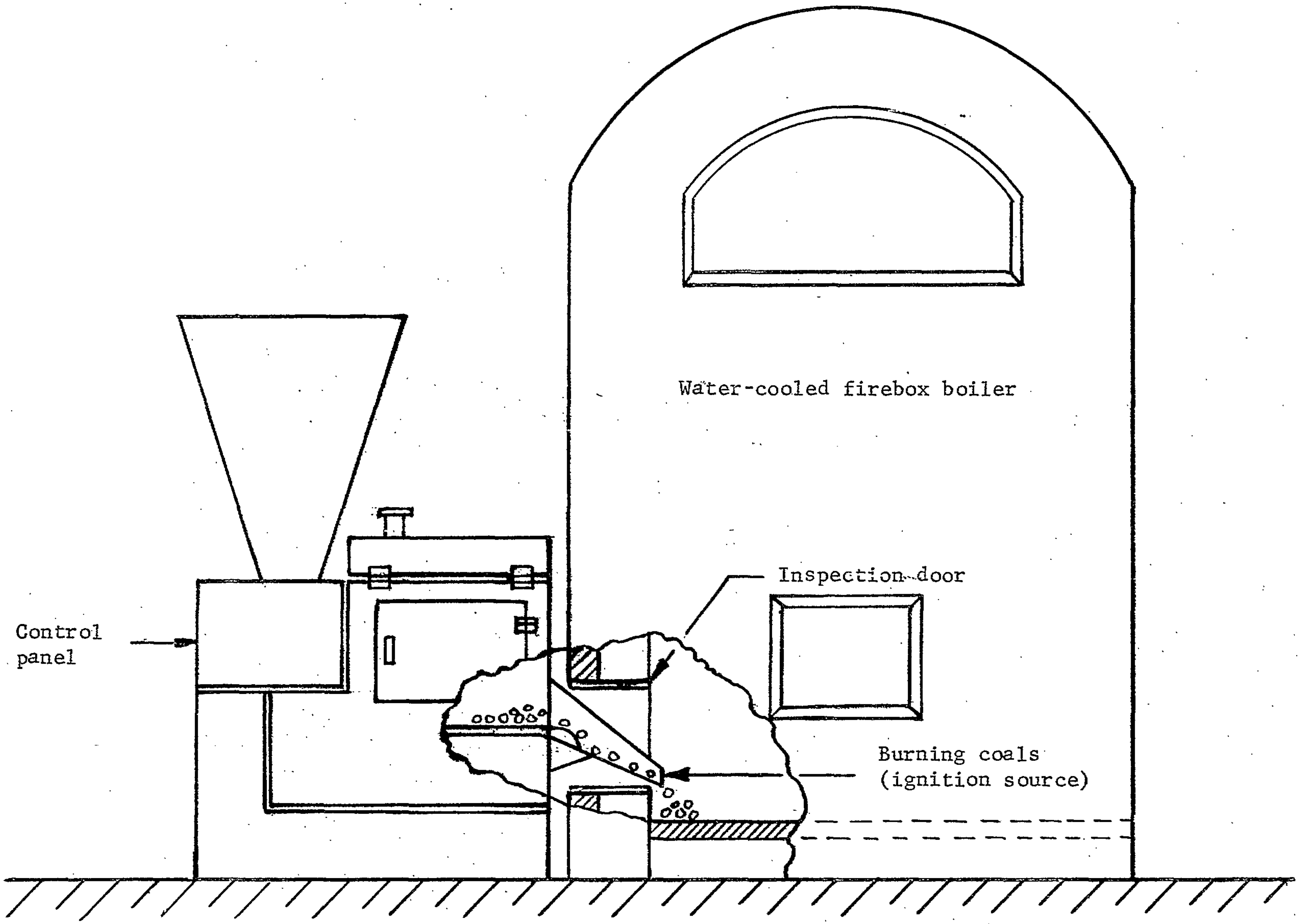

Figure 2. Illustration of the coal-fired pilot light installed on a firebox boiler.

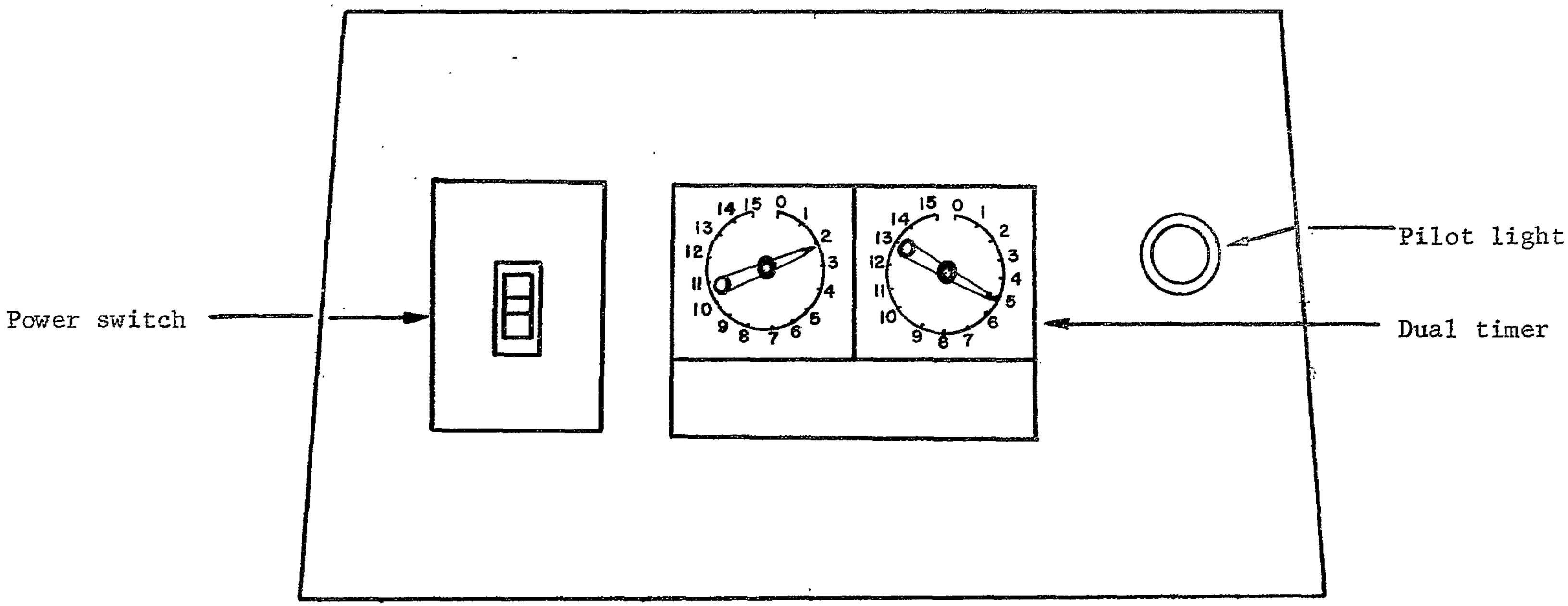

Figure 3. Illustration of dual-timer control panel for coal-fired pilot light.