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TO: Office of the Quartermaster General
Washington, D.C.

FROM: W. C. Coleman, President
The Coleman Lamp and Stove Company

SUBJECT: New Fire Unit for Army Field Range

The Army Range Fire Unit now in use is, in its general plan, of most excellent design. The Army Engineers, who conceived the ideas that have entered into the complete construction of this range, did a good job.

The general idea of the angle iron frame constructed to slide in and out of the range; the use of two tanks, one on either side as far away from the heat of the burner as possible; the general structure of the burner head and the fundamental idea of filtering the lead out of tetraethyl brands of gasoline by an asbestos filter disc still proves to be in my judgment the best way of performing this function.

The troubles which have developed in field use have been due to detail of design rather than to the general concept of the entire unit. No designer produces a perfect mechanical device at the first attempt.

It is to be expected that six years of field experience would reveal many changes that could be made which would overcome the troubles which have been experienced in field operation and thereby give better service in many ways. Such a design is what The Coleman Lamp and Stove Company has undertaken. We have had more than forty years experience in the field of gasoline pressure burners and we have brought to bear whatever of engineering talent and experience we possess to the accomplishment of this task.

In the early years of our experience in producing gasoline burning appliances, our favorite alibi for field troubles was the phrase "not properly operated according to directions". Later we came to understand that this alibi is only a face saving device. Mechanical appliances must work in spite of errors by the operator. If the operator does something continually that he should not do, we design the product so that they cannot. If there is something they should do for successful operation that they do not do, we make it so the product does it anyway. Good mechanical structure must anticipate human error and prevent serious trouble and we believe there is no substitute for proven successful experience.

Our approach to the redesign of the Fire Unit has been:

1. To gather from responsible sources a list of the real troubles which have developed in field use.
2. To analyze the causes which have produced these troubles and
3. To reconstruct the unit so as to remove as far as possible the causes that have been responsible for the troubles experiences.

of twenty-one specific troubles, which have been
tion and in the production of the present Fire Unit.
the causes which seem to be responsible and the
construction features of the new unit that will remove these causes or reduce them
to a minimum.

This is a report of progress and in a few days we will be able to submit the
completed unit to the proper officers in the Quartermaster Department at Washington

Sincerely yours,

THE COLEMAN LAMP AND STOVE COMPANY

W. C. Coleman
President

W. C. Coleman:p
Enc.

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FIRE UNIT - FIELD TROUBLES

Asbestos Filter Chamber:

Cause of trouble: The Filter Chamber is closed by a ground joint 14" long and held only by center bolt of small size. There is too much bolt to hold tightly. Also the cap warps by heat, making tight sible.

Remedied in New Fire Unit: The Asbestos Filter Chamber is stamped steel disk-like plates welded together at edges and tested at factory for leaks. This completely eliminates above trouble.

3. Leaks at Air and Fuel Line Connections. Attempts to tighten with large wrench often breaks connection from Generator Tube:

Cause of trouble: The jam connection is improperly made. Connecting surfaces at flat angle require excessive wrench pressure to tighten. These are disconnected daily for cleaning.

Remedied in New Fire Unit: An acute angle jam is used for Air and Fuel Lines which require less than 1/5 the wrench pressure to make tight. Also they are factory assembled. The burner is so designed that no disconnecting of these joints is required in the field for cleaning parts.

3. Leaks from Generator Tubes due to excessive wear, caused by disassembling daily for cleaning:

Cause of trouble: Daily disassembling of threaded parts is always a hazard, especially when done by untrained men. Crossed threads and stripped threads render equipment useless and require expensive repairs.

Remedied in New Fire Unit: The Generator Tube is eliminated. There is only a dry vapor tube to clean. Only a limited amount of carbon is deposited in this tube. Cleaning out at long intervals instead of daily reduces the hazard.

4. Filler Cap Leaks and Broken Tank Connection for Same:

Cause of trouble: Due to location, the filler cap is subjected to excessive heat, which eliminates use of gasket. A metal to metal joint requires excessive wrench pressure to make tight. Bushings are often twisted from tanks by brute force and lack of mechanical judgment, when leaks at this cap cause tanks to lose pressure.

Remedied in New Fire Unit: The Filler Cap is located in end of Fuel Tank out of the excessive heat zone. Regular filler cap structure proved by 20 years use is employed. The cap is operated by hand. Wrenches do not fit on same so excessive force, which is unnecessary, cannot be used.

5. Lighting Troubles, due to lack of skill in juggling two valves, one for fuel and one for air:

Cause of trouble: Average operator is unable to secure correct mixture of air and fuel for rapid heating and often floods burner with too much fuel causing a bad flame over extended period.

Remedied in New Fire Unit: One Valve operation with Automatic Control of mixture - Air and Atomized Liquid Gas. This lighting valve is the same as used on small "Military Stoves" and Gasoline Pressure Lanterns, with which many operators are familiar.

6. Lighting Troubles, due to liquid fuel getting into Air Tank and then filling air lines at starting, causing the burner to flood with liquid fuel:

Cause of trouble: In present structure this occurs because of the two-valve lighting device. When both valves are open, excess vapor pressure generated in fuel tank by heat may cause a reverse flow from fuel tank to air tank. Then at starting liquid fuel flows through both valves and the burner is quickly flooded.

Remedied in New Fire Unit: In the new unit fuel and air are in both tanks. The pressures in both tanks are equalized at all times, completely eliminating this lighting trouble. Air always flows from top of tanks above fuel level.

7. Lighting Troubles, due to flooded burner, caused by slow vaporization when starting same at low temperatures:

Cause of trouble: At very low temperatures all atomizing devices tend to be slow in generating vapor which means slow starting, which, in turn, means excess liquid accumulation in the burner while heating up.

Remedied in New Fire Unit: The new unit is equipped with a handy "Drain Device" to effectively dispose of such accumulation of liquid without perceptible effect on the burner operation.

8. Lighting Troubles, due to lack of knowledge and lack of understanding as to the correct method of operation:

Cause of trouble: The seven pages of minute printed directions are often never seen by the operator. If seen, are seldom read - if read, are too often not understood. Operation and servicing requires too much specialized skill.

Remedied in New Fire Unit: In the New Unit operation is greatly simplified. All essential directions are stated on one page and the most vital operating directions are on the operating part itself, the same as on Military Stoves and the standardized Gasoline Lantern.

9. Poor Flame Quality, due to misconception as to what kind of a flame is hottest and best suited to the range structure - which requires a long flame, green at slots, shading to blue and then to orange at the top:

Cause of trouble: The air adjustment is left entirely to operator's judgment, which cannot be relied upon. The flame valve structure is like a water hose nozzle and tends to produce a variable spray of fuel through the bunsen tube, hence, it is very difficult to maintain a consistent flame quality which must have a balanced mix of Air and Fuel.

Remedied in New Fire Unit: Air Control is positive and factory adjusted - one position for lighting and one for operation. The flame valve structure maintains a uniformly solid jet of fuel, (not sprayed) thus securing constant maximum bunsen efficiency for intake of air to support combustion.

Poor Flame Quality due to an enlarged Jet Orifice which produces an incorrect mixture of Air and Fuel:

Cause of trouble: When closed this flame valve shuts off at the orifice with a tapered steel needle, which enlarges the orifice when too much force is applied. As valve cools the body of brass contracts much more than the tapered needle stem of stainless steel, thus forcing the orifice.

Remedied in New Fire Units: The New Flame Valve does not use a tapered needle but a straight cleaning pin closely fitting the orifice. No force exerted by operator, or by variable metal contractions can effect any enlargement of the orifice.

11. Removal of Lead is not consistent - at time excellent, at other times poor:

Cause of Trouble: Careless operators fail to adequately clean all sealing surfaces in the filter chamber in which case the fuel by-passes the asbestos filter. This is indicated by lead deposits at burner slots.

Remedied in New Fire Unit: The welded structure of the combined vaporizer and filter makes possible a perfectly sealed filter so that no fuel by-passes the filter in this replaceable unit.

12. Cleaning Troubles when using leaded gas. The Filter Chamber must be opened two times each day, all parts scraped and brushed and wiped off carefully. A new filter is then put in:

Cause of trouble: The job requires cooling down the burner; the use of a big wrench which may break off the retaining cap screw requiring expensive repairs. Cleaning all parts well takes time. It must be well done or leaks occur when again assembled.

Remedied in New Fire Unit: The new Replaceable Welded Filter Disc which also vaporizes the fuel eliminates all this cleaning and leak trouble. It requires less than a minute to replace same, which operates several days with no care or service.

13. Cleaning Troubles - The Generator Tube which delivers fuel to the Filter Chamber leads up rapidly. It requires disassembling and cleaning out daily:

Cause of trouble: Tetraethyl lead is deposited in solid form in any vaporizing chamber. The Generator Tube vaporizes much of the fuel before reaching the filter chamber. To remove the entire assembly for cleaning requires breaking six connections - a daily performance often resulting in leaks or breaks when same is reassembled.

Remedied in New Fire Unit: The Generator Tube is eliminated - the fuel is completely vaporized in the replaceable disk-like chamber which also contains the asbestos filter. All these troubles are completely eliminated.

14. Cleaning Troubles, due to carbon and gums in the flame valve body and orifice of the jet:

Cause of trouble: The major portions of the carbon and gum come from the high temperature distillation fractions and cracking of the vapor by excessive heat. This carbon is then solidified after the lead is filtered out. A considerable portion is, therefore, carried directly into the valve body, causing

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many operation troubles.

Remedied in New Fire Unit: Much larger space is provided in the flame valve for this carbon so same needs cleaning less frequently. More important, however, is the carbon filter screen in the Gas Tube and Valve Assembly, which effectively filters out carbon and gum in the vapor. Since the free carbon and gum content is about 1/10 that of lead, this second filter needs to be replaced only at long intervals of time.

15. Broken Parts Troubles (Very Serious) - now requiring expensive repair assemblies and delays which render continuous dependable operation difficult to obtain:

Cause of trouble: The cause lies in mechanical design. The trouble points are - (1) The ground joint of filter chamber cap. (2) The flat jamb connections of air and fuel lines. (3) The metal to metal filler cap joint required because located in excessive hot zone. These are disconnected daily and require a large wrench and much force to tighten.

Remedied in New Fire Unit: (1) The Filter Chamber is of welded sheet metal construction and is replaceable, (No cleaning at any time.) (2) Standard Fuel Line connections have tapered jams which require only 1/5 the wrench pressure. (3) The Filler Cap is located in a comparatively cool place and a standard hand operated cap is used. The small eight-inch wrench supplied is adequate for all servicing and is a safety factor against breakage.

16. Fire Hazards are as follows: (1) Tank can be refueled by drawing unit out of range a few inches only, while burner is still red hot. Spill a little fuel and everything is ablaze. (2) Leaky joints and Connections. Operators try to tighten same while unit is lighted and a break occurs. (3) A burner structure which if flooded, often spills fuel out by way of bunsen tube. (4) Tanks having no safety blow-out may be exploded by external heat:

Cause of trouble: The Filler Cap is in a dangerous location. The daily disassembling for cleaning causes fuel and air leaks to develop. At low temperatures the burner at starting is almost sure to be flooded. This will happen at any time if the two valves controlling air and fuel are not properly manipulated in starting. All gasoline pressure tanks with no safety blow-out in case of too much external heat are considered unsafe.

Remedied in New Fire Unit: (1) The filler cap located in end of tank compels the operator to remove the fire unit from the range to fill tank. This cools the burner below the ignition point. (2) The daily disassembling for cleaning eliminated. (3) Handy means is provided for draining burner body in case same is flooded - also body will hold a considerable volume of excess fuel without spilling out. One Valve operation with automatic control of Air and Fuel mixture makes flooding far less likely. (4) Both tanks are wet - thus reducing temperature and safety blow-outs are provided.

17. Poison Hazards - As to the affluent gases contaminating the air for breathing, the present unit is considered satisfactory. Laboratory tests show only 3 to 10% of the lead in the gases. The real hazard lies in the twice a day cleaning of the filter chamber and the daily cleaning of generator tubes and flame valves:

Cause of trouble: In this process the deadly poisonous lead compounds are scattered to the four winds by scrapers, wire brushes and cloth wipers. Careless operators do this with open food vessels near.

Remedied in New Fire Unit: The New Fire Unit has approximately the same efficiency of lead removal from the affluent gases, but it is highly efficient in safely disposing of the lead removed. The filter disks holding the lead removed are tightly sealed and are replaced without exposing the poisonous lead compounds.

18. Operators are often confused by multiplicity of Valves in the Front Panel and make errors in handling same:

Cause of trouble: There are no operating directions on the Valve Wheels and, with three separate valves to manipulate, operators sometimes make careless errors even if they know how. Operation needs to be simplified.

Remedied in New Fire Unit: Only two valves to operate and both plainly marked on Wheel what to do:

On the Flame Valve - "First Open Far as Possible,
Regulate Heat as Desired."

On the Fuel Valve -- "Open 1/2 turn - light Burner -
After 3 minutes open as far as possible."

19. Interrupted Cooking Service due to time required to cool burner - disassemble filler chamber - clean thoroughly - replace filter - reassemble parts and then relight same:

Cause of trouble: Construction of unit which makes this twice a day cleaning necessary.

Remedied in New Fire Unit: Complete elimination of daily servicing and at least 90% of all Cleaning Operations.

20. Operators Psychological Troubles:

Cause of trouble: Because of an excessive amount of cleaning, servicing, breakage and fire hazard, many operators become unduly prejudiced against the unit. They just "don't give a dam" and the Unit gets rough treatment.

Remedied in New Fire Unit: A new improved Unit eliminating 90% of the cleaning; uninterrupted service with no leaky joints, a minimum of breakage and dependable operation will change the operator's attitude of mind. He will like the thing and give it a fair treatment.

21. Metal Conservation - The present unit, even with steel tanks, uses 2-3/4 pounds of copper bearing metals. This is a headache in certain quarters:

Cause of trouble: We all know the unnecessary use of Critical Materials cannot be tolerated, under present conditions, for any essential equipment.

Remedied in New Fire Unit: The New Coleman Designed Fire Unit uses only one-half pound of Critical Materials - a saving of 82%.