The Problems of the Laundry Power Plant

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Chicago, U. S. A.

Preface

The papers by our Efficiency Engineer, Mr. F. E. Downing, which appeared as a part of or in connection with TROY TOPICS, attracted much attention at their appearance. The demand for them since has been constant and increasing.

The different papers have been collected, after a thorough revision by Mr. Downing, into this volume, which should prove of distinct interest to the trade, some of whose vital problems are handled here. Mr. Downing will always be glad to supplement these papers by personal correspondence, when fuller information is desired on any subject.

Troy Laundry Machinery Company, Ltd.

Problems of the Laundry Power Plant

A Message to the Man Who Cares

You, who are plant owners, if you would be "up to snuff" and really "The Man Who Cares," should realize that when purchasing fuel, whether it be coal, oil, gas, or wood, the Heat Value must be known.

It is heat that drives the engine and heat that is used in laundry process work.

Fire from the coal can not be put into the engine or laundry machine, but the heat from the coal is put there, using steam as a medium of heat transference, from fuel to engine or process.

Know then the heat value of the fuel you purchase, if you are *"The Man Who Cares."*

The heat in coal will range from nine thousand to thirteen thousand British Thermal Units per pound.

How many heat units are in the fuel you purchase?

Don't you know? Well, it is up to *You to Find Out.*

You are always careful to find out the real value of other supplies used in your plant, but you let the coal man go blithely on his way bamboozling you. *Why?* Don't you care?

"How can we be expected to know the relative value of two coals?" is the oft repeated question we have put to us during our many surveys.

You should be expected to know! All leaders in other industries make it their deepest concern to know about the fuel value, as it is generally the greatest plant overhead.

You need not send a sample of the coal to be analyzed, that would be impractical.

But—

You can and should know how much water each pound of fuel will evaporate! Knowing that, it will be easy to find the relative value of fuels, and prevent the loss due to an entire month's test.

At one time in my plant experience a coal firm's representative claimed to have a coal at $3.15 per ton that was worth $3.25 per ton as compared to the $3.00 coal we were burning at the time.

The weekly consumption at this plant was from eighteen hundred to two thousand tons and great care had to be taken in the choice of fuel, as one day's run with coal that was not right meant an increased cost per K.W. hour that would drive the cost man wild.

We show here the result of the test made, believing that it will be of service to our industry, as it shows how to figure comparative coal tests.

TEST.

Cost of tested coal, $3.15 per ton.
Water evaporated per pound of coal, 6.2 pounds.
Cost of coal being used, $3.00.
Water evaporated per pound of coal, 6.1 pounds.
A = Water evaporated per pound of coal.
B = 2,000 pounds per ton of coal.
C = Cost of coal per ton.

THEN $\frac{C}{A \times B}$ = Cost to evaporate one pound of water.

6.2x2,000 = 12,400 pounds of water evaporated with one ton of $3.15 coal.

$\frac{\$3.15}{12{,}400}$ = $.000254, cost of evaporating one pound of water with $3.15 coal.

6.1x2,000 = 12,200 pounds of water evaporated with one ton of $3.00 coal.

$\frac{\$3.00}{12{,}200}$ = $.000246, cost of evaporating one pound of water with $3.00 coal.

.000254
.000246

.000008 saved per pound of water evaporated with one pound of $3.00 coal.

12,400 pounds of water evaporated with $3.15 coal.
.000008

.099200, lost per pound with $3.15 coal.

12,200 pounds of water evaporated with $3.00 coal.
.000008

.097600 Gained per pound with $3.00 coal.

THEN:

$3.15 coal cost
.099

$3.051 Actual value of the $3.15 coal, tested.

$3.00
097

$3.097 Actual value of the $3.00 coal.

From this you see that mathematical comparison, based on actual test, showed that the $3.00 coal we were using was worth, in Heat Value, $3.097, while the $3.15 coal was worth but $3.051 in actual Heat Value, compared to the $3.00 coal we had been using.

Imagine, if you will, the result, if we had burned the $3.15 coal, on the statement of the coal firm, an entire month, with a coal consumption of eighteen hundred to two thousand tons per week!

Think of the vast quantity of coal, used in all our industry; then make up *Your Mind Just Now,* that *You Will Know* the actual *Heat Value* of the fuel you purchase and help us get *Our Industry,* on the road to *Bigger, Better Practice.*

Make *Efficiency* your *Slogan!* Get down to brass tacks and dig up the faulty practices in your plants, turn on the light that will show them clearly. Let us help *You.*

We can learn as we go, if we but will it so.

Coal Conservation—Chapter One

Now that we have seen the results of conservation, in the marvelous achievements of our loved country, shall we continue to waste?

It has been said and truly, that the waste of the United States would support Europe.

You who are thinking men should find food for deep thought in such a statement and it should give birth to a steadfast resolution to conserve our Nation's resources.

It is unlawful to control a natural resource to the detriment of the Commonwealth.

The wilful or ignorant waste of fuel is controlling a natural resource to the detriment of the Commonwealth and should be unlawful.

Why should it be necessary to coax business men to conserve?

Make it a matter of personal pride to get *all* from the fuel that is possible and thus show an industrial result by the use of our Nation's fuel that will be a credit to you.

Do not stand for the statements so often advanced as a blind for ignorance or neglect, that, "There is nothing to flue gas analysis," "Damper regulation is of no benefit," "We are too small to bother about conservation," for, as a matter of fact, the greatest waste of fuel is found in plants using seventy-five tons or less of coal each month.

All the power at the plant is stored up in the coal.

Steam is the medium of heat transference, from coal to fly wheel, or process.

The correct knowledge of how to get the best results from the coal is not at all difficult, but is rather simple. Engineers will be expected to acquire a thorough knowledge of combustion and rightly so, as it is a most important part of their duties to Know All that happens after the coal is fired.

Savings of from twelve to forty per cent have been made by following the instructions which will be given in this series of articles. It will be my endeavor to shun technical terms and complex formulae as far as possible and to take up the many causes of waste in and about the power plant and explain the remedies.

All performance is based on cause and effect.

With this thought in mind, let us consider first of all, the boiler settings.

If your boiler was set in the open air, steam could not be generated, for the reason that the heat would escape.

We enclose the boiler in a setting to confine the heat and to promote combustion. The more perfect our setting is the more efficient will be our result.

Bricks are porous and the "Pull" of the stack will cause infiltration of air. Cracks will leak air through the setting. Either of these defects or a combination of both is the reason for great waste of coal at most of the plants I have surveyed.

Thoroughly soak asbestos wicking in fire clay at about the consistency of paint and calk it deep into the cracks; next carefully cover the entire setting, including the top, with a good boiler covering cement. Be sure that the boiler covering you purchase is not a tar compound as the life of tar for inside purposes on hot boiler settings is short and it will peel off.

The cement will close up all of the small cracks and stop up the pores of the brick making the setting air tight.

EFFECT—Air leaking through cracks and porous brick will be stopped showing an immediate coal saving that will at once offset the "First cost" of the repaired brickwork. New boiler walls should be covered as this infiltration of air is serious.

Remember that all the air that leaks through the setting tends to cool off the boiler and gases and must be offset by burning expensive coal before steam can be generated.

Close attention should be given to the clean out doors and flue cap, also to the boiler front where it joins the setting and to the top of the boiler where it joins the setting, also to the blow off pipe opening.

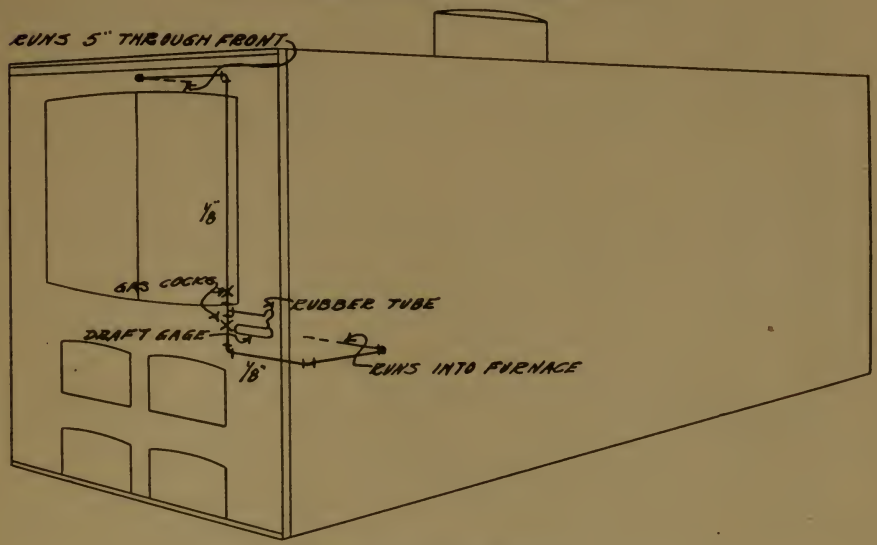
Mix dry asbestos and boiler covering cement so as to form a stiff putty and apply it to the jam of the doors; on the face of the doors apply graphite and oil to prevent sticking, then force the doors shut. An air tight gasket will be formed by this method. Use this putty to stop up the leaks around the boiler front and the top of the boiler where it joins the setting.

In a later paper gas analysis will be taken up, also the subject of excess air, and it is important that leaky settings be repaired; the bonus system will also be explained as it is generally successful in getting economy.

The next paper will treat on the care of the heating surfaces and the heat conductivity of the boiler shell.

Improvements are but the means to an end—Economy.

Coal Conservation—Chapter Two



DRAFT. GAUGE CONNECTION

It is our ambition to aid in the work of improvement at the power plants by calling attention to the ways and means of making the necessary alterations, also by experimenting to find methods and formulae that will enable yóu to keep down the cost of the work as much as possible.

Since our last paper we have found that boiler setting cement, used to stop the infiltration of air through the brickwork, can be made at the plant at a material saving.

Measure the side walls top and back of the setting, to ascertain the total square feet to be covered. For each hundred square feet purchase one and one-half gallons of black asphaltum paint; for the entire work purchase a large bag of asbestos cement. Mix the asbestos cement and the asphaltum to the consistency of mush, and apply it to the brickwork with a stiff paint brush. Get as much asbestos as you can into the asphaltum for a good body. If the walls are very porous it will be necessary to apply a second coat.

Many of the cements for this work are tar compounds. Tar will peel off after a time, as it is not the material to be used for inside purposes.

The asphaltum compound will dry with a gloss making a neater appearance.

We now assume that you have stopped all leaking through the side walls, top and back, around the doors and blow off pipe and that all the air that gets to the boiler must go through the grate and the fuel bed.

We are now ready to consider flue gas analysis, draft regulation and combustion.

To understand combustion and gas analysis, it is not necessary to have a knowledge of chemistry. The apparatus for making the analysis is simple, low in cost and will pay for its cost many times over.

Combustion means the burning of fuel.

Carbon monoxide is incomplete combustion and is known as CO.

Carbon dioxide is complete combustion and is known as CO_2.

For all practical purposes we need not consider any element but CO_2 or carbon dioxide.

CO_2 is the result of the mixing of the oxygen in the air admitted through the fire and the carbon in the fuel being burned.

There will be 14,500 B.T.U. of heat liberated for every pound of CO_2 gas generated.

There will be 4,450 B.T.U. of heat liberated for every pound of CO gas generated.

The difference in these two temperatures represents the great loss for each pound of CO_2 burned to CO because of excess air.

For instance—when we make an analysis, if we find 6% CO_2 our stack temperature will be around 750 degrees Fahr., and our loss will be $320.00 in every $1,000.00 we pay for coal at $3.50 per ton.

If we find 12% CO_2 and a stack temperature of 550 degrees our commercial loss will be nothing. *See the need of a knowledge of combustion.*

We install a draft gauge in a manner similar to that shown in the cut on the opposite page so as to know where our draft should be kept.

The apparatus to use is either the Dwight or the Hays.

We now insert the tube of the instrument into the last pass of water tube boiler or into the breeching of a return tubular boiler on the boiler side of the damper at a point where a fair sample of the gas can be had. Be careful that the tube is not inserted in an air current.

A sample of the gas is then pumped into the instrument and the sample analyzed.

If our analysis shows less than 12%, we have excess air and it is our purpose to find the cause.

We first see that the fire is even and that the fuel bed is from six to ten inches thick, depending on the grade of coal used; next we examine the clean out doors for leaks and also the walls. If we find the walls, doors and blow off pipe are tight, we know that we are admitting too much air.

Close off the damper part way and take another sample. If this second sample shows 8% CO_2 we are improving our condition. Close off the damper a little more and take another sample and keep up the good work till we get 12% to 15% CO_2.

We are operating our draft gauge with the tube leading to the breeching connected to the gauge.

The instant we get 12% to 15% CO_2 we carefully note the point where the fluid stands, as that is the point our instrument has established as the amount of draft required to get the best combustion.

We now know the point our draft gauge must indicate to get the most economical result and it is now up to us to use that draft gauge with intelligence. If we note that the fluid has moved over showing less draft, after a time, it is due to an air leak through the fire, caused by the coal being burned away. Fill up the hole in the fire at once and the fluid will at once move back to the point where it belongs.

If we note that the fluid has moved over the other way, showing more draft, we know that the fire is dirty, due to clinker or ash; and, when the fire is cleaned, the fluid will move to its proper point.

We have a means at hand that will serve to show what is going on in the furnace; there is no guess about it either. *We know.*

After the gauge has been studied and used a day or two, we find that we need not touch the fire until the fluid tells us that it is time to give attention to the fire.

The way firing is done is to fill in the burned out places, when the draft gauge tells us that we have air leaks. It is not proper to fire all over the fuel bed each time the fire doors are opened, also we need not clean the fire, until we *know* that it is necessary. Let the draft gauge be your guide to fuel conservation.

If we have a fluctuating load it will be necessary to take analyses as the load changes, so as to establish the proper draft for all load conditions.

When coal is burned under a boiler the heat is distributed in several ways. Most of it is transferred to the water within the boiler, causing the generation of steam; twenty to sixty per cent of it is lost up the stack and this loss depends on the skill of the engineer.

The temperature of the escaping gas should be around 500 degrees. If we take the temperature of our gas and find that it is 500 degrees we have a condition that is very good and it should be our deep concern to keep it at that temperature. If we find that, after a time, the temperature has gone up, let us clean the flues at once for the reason that the soot in the flues is insulating the tubes from the heat and the heat escapes before the water can absorb it.

All the heat of the escaping gas above the temperature of the air and coal was caused by combustion.

The heat lost with every pound of gas, in B.T.U., is the product of the number of degrees difference in the temperature of the air entering the furnace and the gas in the breeching, multiplied by the heat required to raise the temperature of one pound of gas one degree.

The heat required to raise the temperature of one pound of water one degree is one B.T.U. This is known as the specific heat of water.

It is important that the specific heat of various materials be known. The heat required to raise the temperature of one pound of iron one degree is 0.13 B.T.U., which is about one-eighth as much as for water. The specific heat of flue gas is 0.24.

From this you will see that heat is elusive and great care and attention is needed to insure economical operation.

Watch the air leaks through that fire. A spot ten inches square will drop the CO_2 from 12% to 6%.

Savings of from eighteen to thirty-four per cent may be made by the proper handling of your combustion conditions.

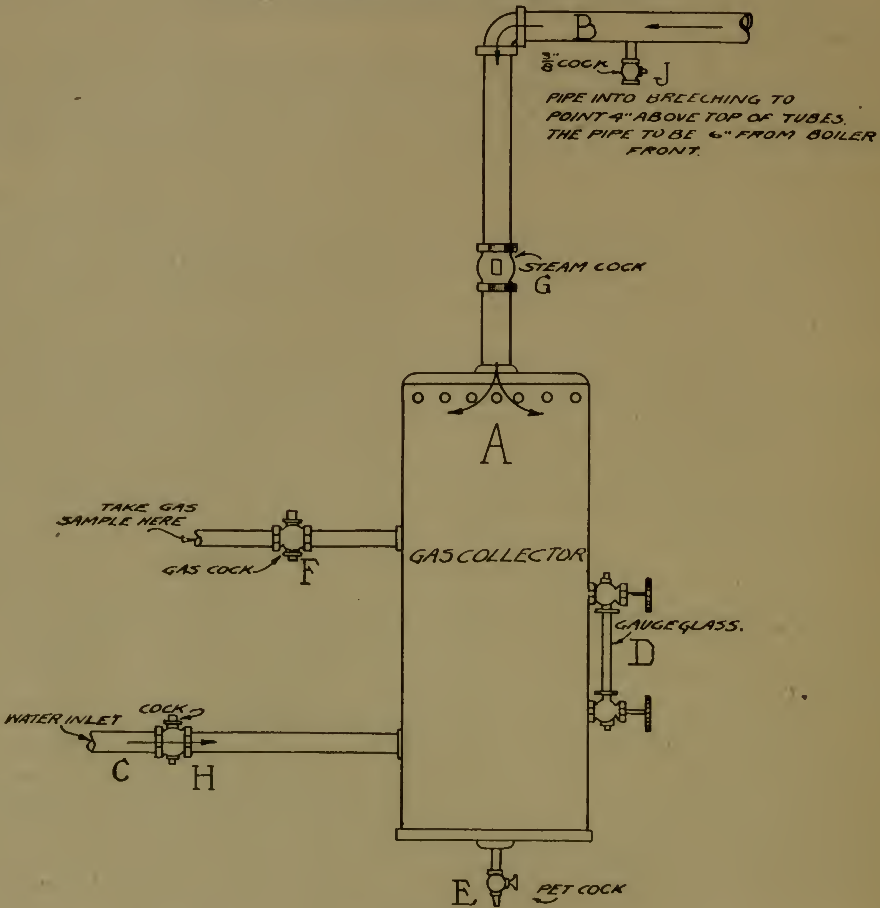
A large plant in Chicago is now operated with a daily consumption of coal of four tons while formerly six tons were required. This saving amounts to ten dollars a day or three thousand dollars in a working year of three hundred days.

We had intended to take up the subject of the care of heating surfaces and the heat conductivity of boiler shell in this paper but will defer it until we have covered combustion.

In the next paper we shall give a cut of a gas collector for taking a collective gas sample for an entire day, also the bonus system.

We shall be greatly pleased to answer all inquiries on any of these papers and to send detailed information on any subject, or apparatus.

Coal Conservation—Chapter Three



In the second chapter of this series on coal conservation, the most ıpproved method of installing a draft gauge was shown.

The draft gauge is an Ellison No. 20, which is not expensive, and is ıll that is required to give you the economy derived from draft regulation.

We find several draft gauges being used when making our surveys, ome of them very expensive and not at all superior to the single Ellison No. 20 Gauge. No matter how the draft gauge is made it is on the same ɔrinciple of the fluid being displaced by the "pull" of the stack, and it is ıot wise to be talked into buying a gauge costing more than the Ellison No. 20, as this gauge will do all that any gauge will do.

In the second chapter we gave directions for the operation of the draft gauges and taking the gas tests.

Taking the gas test and adjusting the damper, then forgetting both, vill not show the desired results, as it is only by careful, consistent managenent of these instruments that a uniform constant result can be obtained.

No matter how hard we try to perfect a process there is always the human element to contend with. Some one will not care. The result is loss of money.

To insure careful attention to the principles of combustion, a bonus system has been devised at many plants and it is gratifying indeed to note what this system has brought about.

It is the pride of accomplishment that makes men successful, but it seems to be impossible to get men to realize this fact. We must offer a prize for good service.

It makes no difference whether we like it or not, it is the only way we can hope for co-operation from our employees.

The cut shown in this chapter is that of a gas collecting apparatus, easily made at the plant, cheap in cost, and as good as any collecting device for our purpose.

The apparatus is set at the side of the boiler and is made of a galvanized water tank and a few fittings.

Run a one inch pipe out to the top of the tank, into the breeching of the boiler, to a point about four inches above the top of the top row of tubs and have the end of the pipe run through the boiler front six inches.

In the bottom of this pipe near the boiler front have a ⅜" valve.

On the side of the tank have a water gauge glass, in the bottom of the tank a ½" pet cock, on the side opposite the water glass a ½" cold water line, and about one foot above the center a ¼" gas cock and nipple.

The operation of this device is as follows:

As soon as the boiler is fired in the morning, open cock G, cock J and cock H.

Water will enter the tank through pipe C filling the tank until the water runs out of cock J. Then close off cocks H and J, leaving cock G wide open; next, so adjust the petcock E at the bottom of the tank, that a full day is required to empty the tank.

As the water runs out of the tank the flue gas will be drawn in so that at a set time, say four o'clock each afternoon, a sample representing the average gas generated for the day may be pumped into the gas analysis instrument and analyzed. Be careful not to let the tank get entirely empty, or air will enter the petcock at the bottom of the tank spoiling the sample. Before using the instrument, see that E, H and G are closed off tight, then attach the tube of the instrument to F and pump a sample of the gas out of the tank.

By the use of this device an average sample of the entire day is had, and, if the fireman has been careless, it will show him up.

Let him be careless for any part of the run and the percentage of CO_2 gas will be low, showing neglect of duty and *waste of your fuel.*

To make it an object for him to care about his work, the following bonus is paid him:

For 15% CO_2, sixty cents per day.
For 12% CO_2, fifty cents per day.
For 10% CO_2, thirty cents per day.
For 8% CO_2, ten cents per day.

For less than 8% CO_2 no bonus is paid, and the reason should be found why the CO_2 is low, at once.

Remember that if you get as low as 6% CO_2 your waste will be as much as thirty per cent.

The bonuses as listed are the average being paid and you will be surprised at the results if you will go right after this saving.

The time when engineering means filling oil cups and burning coal is passed, engineers are required to *know* all that makes for economy and it is up to the plant owner to see that he gets service for wages.

The time is not far distant when men who are trusted with our nation's fuel will have to prove that they understand combustion.

In the next paper we shall take up the care of the heating surfaces and explain the cause of other losses due to insulation.

Can we all be as big as the industry we are a part of? *Why not?*

Coal Conservation—Chapter Four

We have gone into gas analysis, draft regulation and the ways and means of the proper combustion of fuel and have shown the need of care in the handling of the furnace so as to get the greatest good from the fuel.

There are other factors in the economical firing of fuel, which, if neglected, will cause an offset of all the benefits to be derived, which were shown in the previous papers on this important subject of fuel conservation.

The proper care and attention to the heating surfaces are of great importance and there can be no doubt of the savings made, in fuel, boiler capacity, repair costs and life of the boiler, where the heating surfaces are cared for.

The accumulation of soot and scale will lower the absorption of heat, or, in other words, the heat conductivity of the metal will be cut down, which causes a drop in capacity and the consumption of added fuel.

The heating surface of a boiler is that part of a boiler, covered with water on the inside and exposed to the direct action of the hot gases on the outside, or fire side.

Remember that a boiler H.P. is the equivalent of 34.5 pounds of water evaporated from and at 212 degrees Fahr. also equivalent to 33,479 B.T.U. of heat per hour.

Can you not see from this statement that dirty, ill kept heating surfaces will materially affect the economical production of power?

Some authorities give 10 square feet of heating surface as the equivalent of one H.P. We maintain that 15 square feet per H.P. is the proper rating.

Assuming that 10 square feet is correct and that a deposit of scale and soot has decreased the heat absorption 10%, then the boiler will be reduced in capacity 10% or one-tenth, and, if forced to get the output of power, 10% more coal will be used, which represents a waste of 10% in fuel.

When one stops to think that $\frac{1}{16}$-inch of scale is given variously as a waste of from 12% to 16%, it seems that there is need of deep concern on the part of coal purchasers.

The heat lost through the boiler walls by radiation is easily 4%. If your boiler walls have an air space, fill the space with sand as this will cut the radiation waste in two.

While most soot is black, (resembling lamp black), we have seen it all shades of brown, grey and, in some instances, dark green. It is always present regardless of the rate or conditions of combustion and regardless of the kind of fuel used.

Soot is composed of unconsumed carbon and ash. A part of all soot is tar-like in nature, which causes it to bake on the flues, compelling the periodical use of the flue scraper. What these periods shall be can only be determined by a careful painstaking inspection by *the man who cares*—let us hope that this man is the engineer.

The flue blower should be used daily and in many instances the scraper should be used each morning and the blower at noon.

Soot has been proven to be five times better as an insulator of heat than pure asbestos.

As the draft increases the deposit of soot will be greater.

New clean boilers have shown an increased coal consumption of 5% after three days operation due to soot deposits.

The removal of soot is a hard, dirty job and this is the reason it is so often neglected rather than ignorance of the consequences.

Scale is the other cause for expensive power production.

While a light deposit of scale may not be dangerous at light or ordinary loads, forcing the fire to handle a sudden extreme load will dry out the scale, which then becomes hard and flinty, and it will entirely insulate the water from the boiler shell. The rate of heat absorption will be cut so low that there is great danger of overheating the plate cracks or blisters.

Scale is formed by carbonates and sulphates of lime and magnesium, oxides of iron and aluminum and silicon. Chlorides of magnesium and sodium, also mineral and organic acids, cause corrosion if free oxygen is present.

Corrosion is an action that eats away the plate, greatly reducing the factor of safety and should be given prompt attention.

During surveys we have found it so thick that it caused a waste of 20% in fuel.

A boiler plate 1-10 inch thick will conduct heat ten times faster than a boiler plate 1 inch thick. Why then, should you increase the thickness of your boiler plate by allowing scale and soot to accumulate, thus reducing the capacity output and increasing the fuel and maintenance cost of operation?

Softening the water is the best scale preventative; next comes a good boiler compound, carefully selected to handle the chemical nature of the scale deposit at your plant.

There is no boiler compound that we know of except boiler graphite, that will meet all conditions. For this reason be careful in your selection of a compound for your individual condition.

In an earlier paper we have given the subject of the danger from scale and will refer you to it for information.

This chapter closes the subject of the combustion of fuel.

Now, you who are plant owners, please answer. After having read all the articles on this important subject, are you prepared to sit down and discuss the subject of combustion and general fuel conservation intelligently?

If you cannot are we to assume that *you* who pay are not *the man who cares?*

Read those articles all over again, make them a part of your business sense, and know what you are talking about when you discuss this subject with your engineer. He will know that *you know,* and the results will put your plant in a condition to compete with plants in other industries.

Ask the Troy Laundry Machinery Co., Ltd., to aid you in all things pertaining to the economical output, plus quality, and we will respond at once.

Future papers will treat on subjects of general interest to the laundry industry.

Be interested enough in your own welfare to make a study of the causes for excessive costs.

Combustion

The ever increasing cost of coal added to the fact that the output does not equal the demand makes it imperative that the principles of combustion be thoroughly understood. Our duty to the trade demands that we keep down the cost of production; our duty also to our beloved nation is to conserve every material thing. The value of a thorough knowledge of the principles of combustion cannot be overestimated.

There is nothing difficult about the correct methods, nothing requiring great skill or engineering ability, but rather an understanding of the methods and the determination to adopt these methods in the daily management of the boiler plant.

Let us first call to mind the facts generally understood as to the distribution of the coal on the fuel bed.

The thickness of the fire is governed by the grade of coal and the nature of the load on the boiler. It is from four to ten inches thick. Thin fires must be carefully watched for the reason that the coal will burn away in spots, allowing an excess of air to rush through, disturbing the whole process of combustion and lowering the efficiency.

The coal should be fired often and must be evenly distributed over the surface of the fuel bed. Firing on side at a time, called the alternate method, is best.

Do not poke the fire unless absolutely necessary. The man who is a "poker burner" is not an economical fireman.

Nothing need be said as to how the shovel is handled, as the knack is quickly acquired and is known by all engineers and firemen

Poking or otherwise disturbing the fire bed will cause excess clinker, will waste coal into the ash pit, means hard work Also the cold air which is admitted over the fuel bed lowers the overall efficiency.

Never regulate the fire with the ash pit doors, always use the damper. The correct handling of the damper is most important, as it means a condition that will greatly add ot the conservation of the fuel.

Keep the fire level, always being careful to fire on the thin places, so as not to allow bare places on the grate, as the rush of air over the fire will cut down the efficiency.

A comparison of the temperatures will be an education for anyone interested, as it is apparent that the cold air rushing over the fire represents a loss found quickly by deducting its temperature from the temperature of the gases leaving the breeching.

If the coal is coked, it may be broken up with the rake. The tendency of the coal to coke is governed by how thick it is fired. If fired thin, the coking is very slight, if it cokes at all.

How often coal should be fired depends on the load, the quality of the coal, the draft, and is a local condition that should be met by the good judgment of the engineer in charge.

When coal is first fired, volatile matter is given off in the form of gases and tar vapors, and a large amount of air is needed to consume these vapors. This air is admitted over the fire, through the openings in the fire doors. This air should be gradually reduced. Various appliances have been used to control the admission of the air over the fire, as a large amount is needed at first and should be reduced as the combustion of the volatile gases becomes more complete. One very good method is to fasten a Blount door check to the boiler front. This check can be regulated so as to close the door in any time desired. This will take care of the air regulation, if the same amount of coal is fired each time. This device will effect a considerable saving, as well as reduce smoke, if properly installed and intelligently handled.

We will now consider the damper, draft regulation, draft gauge, and what the careful use of the damper and the draft gauge will mean in the conservation of coal.

The damper is all that is between the dollars you pay for coal and the great outdoors, and the proper regulation of the damper should be given as much concern as the regulation of any other part of your plant.

While at a large refrigerating plant in a Ohio city, I instructed the engineer as to the regulation of the dampers on nine large boilers, and a saving of a ton and a half of coal was made on each boiler every twelve hours or a net saving of thirteen and one-half tons every twenty-four hours. This will serve to show the importance of draft regulation.

The damper cannot be regulated by guess work, and a means of actually knowing when the most economical adjustment has been made should be at every boiler plant. The means is an instrument for the analysis of the flue gases and a draft gauge to indicate the correct position of the damper in relation to the draft.

Before applying either one of these instruments, make your boiler setting air tight by applying a good boiler setting cement to the outside of the walls, and be sure that there are no air leaks around the flue caps, boiler front or cleanout doors. Having attended to this, we are ready to use our gas analysis instrument and draft gauge.

The instrument we find to be the best suited for general use is a direct reading instrument and is as simple to use as a steam gauge. All that is done is to connect the tube to a short piece of pipe, insert the pipe into the breeching near the boiler plant, so as not to let an air leak affect the test, and pump a sample of the gas into the instrument. There is a gauge that reads direct like the steam gauge that will record the percentage of carbon dioxide gas, and on the percentage of this carbon dioxide gas depends the economy of your combustion.

One pound of carbon dioxide gas will give off 14,500 B.T.U.'s of heat, while one pound of carbon non-oxide gas will give off only 10,000 B. T. U.'s of heat. Carbon dioxide is known as CO_2, and it will be generated by the mixing of the right amount of air with the carbon. Carbon monoxide is decomposed CO_2 and is the result of poor combustion. It is known as CO.

The condition generally found is 5 per cent CO_2 and a stack temperature of 750 degrees. When this condition exists in your plant, $320.00 worth of coal in every $1,000.00 worth is being wasted up the stack.

The best practical condition is 10 per cent CO_2 with a stack temperature of 550 degrees. At this condition the losses will be only $62.00 in each $1,000.00 worth of coal burned. (Above figures are based on coal at $3.50 per ton.)

The laundryowners in a city should club together and get an instrument and there should be a draft gauge on every plant, for the reason that this draft gauge will indicate the position of the damper found to be correct by the gas analysis.

If this plan is followed out there will be a great saving on your plants. There is a direct relation between the losses on your plants and the percentage of CO_2 in your flue gases.

(The instrument referred to is the Dwight, made by the Dwight Mfg. Co., Chicago, Ill., and full directions will be found with each instrument.)

Too much grate surface is another source of loss. Carefully estimate your total load and divide this estimate by three. The answer will be the area of the grate surface. A hotter fire will be had, as the velocity of the air will be greater through the grate and it will be found that about 20 pounds of coal will be burned on each square foot of grate surface, which is correct. To reduce the grate surface temporarily, lay fire brick on the grate so as to cover a portion of it up; when sure that the area has been figured correctly, have the grate and furnace reduced permanently.

The choice of the proper coal for your plant is of great importance and an evaporation test will determine just what coal is the best for your plant. If the boiler is fed with direct return traps, with a lifting trap to handle the make-up water, a constant evaporation test will be had. The "guess idea" will be gone and you will *know* what coal is the best for your plants.

The Troy Laundry Machinery Co., Ltd., is deeply interested in the economy of laundry plants and you are cordially invited to apply to us for advice on any subject of economy on the plant.

Public utility companies have had their prices regulated by the state or government and this action did more for the conservation of power than could have been done by any other means. The Turbine Condenser, and many other devices to reduce the cost of operation were the result of this price regulation. It is not the big plants that are operating under careless management. The increasing cost of all power supplies will make wasteful conditions, but the small plants, and this is largely the result of it necessary to stop all waste and practice conservation to the limit and our Department of Efficiency Engineering stands ready to be of any constructive service at any time.

Management and Care of Boilers

The following directions are for the general aid of firemen with the thought of aiding in the safe management of this important part of the plant's equipment.

Firing—Maintain the fire about ten inches in thickness as a usual thing for free burning coal and not so thick for coal that is of the slow burning variety. At all times see that the fire is even; fire regularly, but not heavy; the method of firing on burned out places is good. Try the alternate method, that is, first fire one door and then, after the coal is thoroughly ignited, fire the other door. Keep the fire free of ashes and clinkers, paying close attention to the sides, back and edges. Do not allow the ash pit to become filled with ashes. Above all do not use the fire tools unless absolutely necessary, as the fire will be ruined, much coal will be wasted into the ash pit and also clinker is formed by the careless use of the fire tools.

Water Level—The first duty of everyone in any way connected with the power department, on entering the boiler room, is to examine the water level. Much has been said and written on engineering, but the water level is the most important condition in or about the plant

If more than one boiler is operated, do not stop after trying the gauge-cocks on one boiler, but try them all. Never take anything for granted in a boiler plant.

Low Water—If the water is found to be low, first close the damper and then cover the fire with wet ashes in quantities great enough to reduce the head. *Do not touch the water feed. Do not open or close any valve in the plant.* If you have been careless and allowed the water to get low, do not make the mistake of taking a chance, but be sure of "Safety First;" be big enough to cool the boiler down; the owner will not blame you half as much as he would if you should take a chance and run the risk of blowing up the plant and probably causing loss of life as well. After the fire has been banked with wet ashes or fresh coal and is right to draw without increasing the heat, do so and when the boiler is cool enough examine for possible damage and then start up.

Foaming—Foaming is caused by oily, soapy or dirty water or by the changing from fresh to salt water. You will know the boiler is foaming by the water in the gauge glass bobbing up and down in the gauge glass and not showing a true level. To find the true level, first throw fresh coal on the grate, close the damper and slowly stop the engines, pumps and all steam flow from the boiler; the water will at once come to a true level. If the water is high enough in the gauge glass, you may start up at once, then open the blow-off and start the pump gradually renewing the water in the boiler, until it has been entirely changed.

External Corrosion—Is caused by the generation of sulphuric acid, due to the attraction of the sulphur gas by the water, where there are leaks. The action of this acid is very bad and will eat the plate away, reducing the factor of safety of the joints and making it necessary to cut down the pressure. First stop the leaks, then carefully clean the place with a wire brush, paint with red lead, and give the needed attention that will prevent a like trouble.

Blowing-Off—Never blow off the boiler when there is more than 30 pounds pressure on the boiler, and have some one watch the gauge glass while you are blowing down. The condition of the water being used as feed water will govern the amount to be blown off and how often it is to be done.

A surface blow-off should be installed where the water is muddy as it will enable you to skim off the surface during the operation of the plant. (See chapter on Combustion.)

Water Feeding—Never feed cold water into a hot boiler as the unequal expansion and contraction will cause strain on the joints and rivets, fractures and explosions.

Feed Lines—Examine the feed lines each time the boiler is down for repairs or cleaning, as the stopping up of the feed line is costly in loss of time and may cause a serious break.

Safety Valves—Do not allow the valve to pop often, as it will cause a great waste of fuel; also the sudden temperature change on the boiler due to lowering the pressure will put expansion strains on the boiler that will weaken it. Raise the valve from its seat twice each week, also be sure that the valve is of capacity to relieve the boiler of over pressure.

Pressure Gauge—Have the gauge tested if it does not stand at zero when the steam is down and does not stand at the pressure you know it should stand at when the boiler safety valve is popping.

Water Gauge Glass and Gauge Cocks—Do not rely on the gauge glass altogether, but try the gauge cocks, also blow the gauge glass out at least three times each day.

Boiler Feed Pump—Give this pump the attention that will insure its constant operation. Two devices should be on every plant to be used as boiler feed.

Scale—The cause of great waste of fuel and damage. Carefully clean all scale and prevent its formation. (See paper on Combustion.)

Soot—Keep the soot cleaned out, as it is an insulator. The exterior of the boiler should be kept free of soot and dampness as external corrosion may be caused.

Bags, Blisters and Cracks—Call in a competent boiler maker at once and have the needed repairs made.

Fusible Plugs—Keep these plugs clean, as they are of great importance in the prevention of boiler trouble. If dirty, they will not fuse.

Settings—Stop up all cracks and cover the setting with boiler setting cement, as the infiltration of air through settings is very wasteful of fuel.

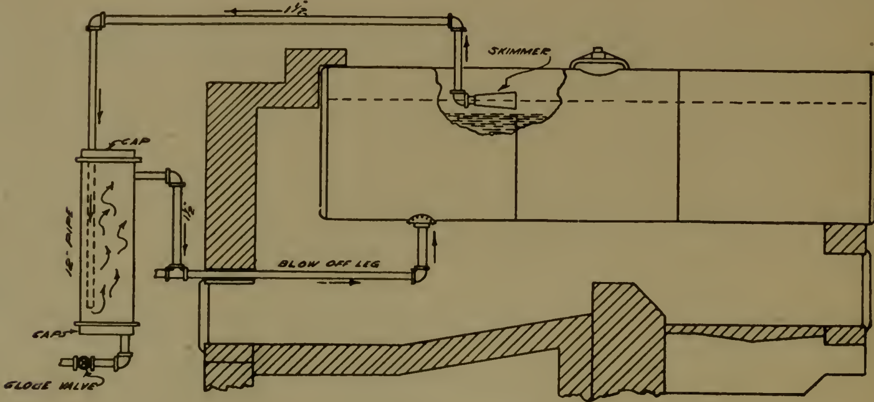
Galvanic Action—Produces corrosion and is stopped by hanging about ten pounds of zinc on the tubes inside the boiler.

Raising Steam—Always open the gauge cocks to release the air while the steam is being raised, and not raise the pressure rapidly, as the seams may be burned.

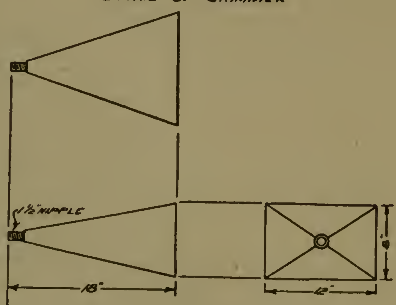
Laying Up—When laying up a boiler, fill it full of water and put in about twenty pounds of washing soda to each hundred horse power.

Incrustation or Scale in Boilers

SKIMMER FOR BOILER SCALE PREVENTION



DETAIL OF SKIMMER



The precipitation of mineral substances or mud that is held in solution by boiler feed water is the cause of scale or incrustation.

This deposit must be removed as fast as it accumulates or a heavy scale will be formed over the plates and tubes. This deposit is not only dangerous because of the tendency to overheat the plates, which will cause bagging, but also the conductivity of the plates is greatly decreased because of the insulating effect of the scale.

The loss consequent to a deposit of one-sixteenth of an inch of scale will demand an increased fuel consumption of 15 per cent and the loss due to deposits of greater thickness will be in proportion.

Carbonates and sulphates of lime and magnesia are the most troublesome.

When water containing carbonate of lime is heated the carbonic acid is driven off and the carbonate is deposited on the plates and tubes.

Scale formed by carbonate of lime is soft, while that of sulphur formation is very hard.

If oil or grease is present, the danger of overheating the plates is greater. Great care should be taken to prevent oil deposits in the boiler. Close attention to the condition of the oil separator will prevent this.

To prevent the formation of scale in the boiler, the sediment should be removed before it has baked solid to the plates and tubes.

Soft or treated water is of course the best for boiler use, as the scale deposit will be very light and generally there is no scale at all. Where foreign matter is troublesome, the water may be filtered through coke.

There is no one boiler compound that will meet all conditions of scale, as the water used in various sections of the country will not have the same content of solids.

Boiler Graphite carefully used is one of the best scale preventatives, as it will form a coating on the plates and tubes which will prevent the deposit of scale. The following formula will be found to meet most conditions of scale deposit and may be made at the plant at comparatively small cost:

100 pounds Glauber Salts; 100 pounds 58% Soda Ash; 10 pounds powdered Slippery Elm; four pounds powdered Sumac; 50 gallons water.

Boil two hours by inserting steam pipe. Stir before using.

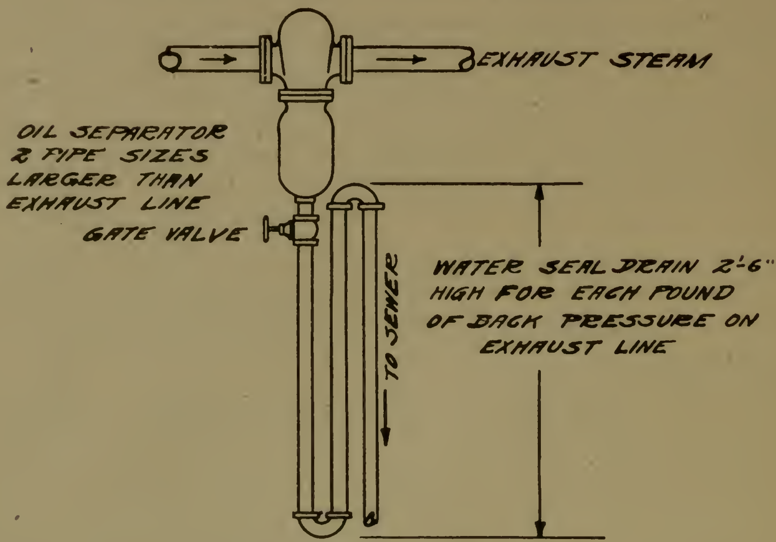
Use one pint per 100 H. P. daily until scale is removed; then use one-half pint daily.

Almost all of the scale forming sediment is held in suspension for some little time and if the device shown at the beginning of this paper is installed this sediment may be removed before it has time to be deposited and baked solid on the plates and tubes. The device consists of a skimmer at the surface of the water fastened to a 1½-inch pipe running up through the top of the boiler, then down through the settling chamber. It will be noted, on examination of the drawing, that this pipe continues down on the inside of the settling chamber to within one foot of the bottom. A 1½-inch pipe is then run from the top of the settling chamber back to the boiler blow-off leg, which gives a constant circulation from the skimmer down through the 1½-inch pipe into the settling chamber. The velocity of the water keeps the sediment in suspension until the water enters the settling chamber, where the velocity is reduced, allowing the sediment to settle to the bottom of the settling chamber. From here it is blown off through the blow-off valve.

We have designed this device so as to make it cost little. It can also be made at the plant.

The use of this skimmer to remove scale-forming sediment and the compound given above should be of assistance to boiler owners in the removal of objectionable scale, saving boiler repairs and fuel, and obviating the possibility of costly accident.

The Separation of Oil From Exhaust Steam



The by-product value of exhaust steam for hot water heating is so reat that it may be said that the power in a laundry plant is a by-product f the hot water.

Our tests have proven to us and to our clients that the most profitable nethod of heating water for laundry work is to bring the exhaust steam n direct contact with the water to be heated, as in an open heater or by the ank method described in a recent article on water heating.

The reason is that the exhaust steam is absolutely pure and free of all ardness, and, when brought in direct contact with water to be heated, it s condensed and tends to soften the total hot water.

We can refer to plants that have reduced the cost of washroom suplies 15%, because of this softening, which is due to the exhaust steam ondensing and mixing with the total water. Further there is bound to be considerable saving in water. In many plants using a closed type of eater or coil in the hot water tank, the condensate from the exhaust steam s wasted to the sewer. We will let you be the judge of your own saving y calling your attention to the following figures: An engine developing 0 H.P. per hour, will use 1,500 lbs. of steam per hour, which means 1,500 bs. of water, or 15,000 lbs. of water per day of 10 hours, or 54,000 gall. er year of 300 ten-hour days.

To accomplish these results, it is necessary to remove all oil from the xhaust steam.

To remove or separate oil from exhaust steam, an oil separator two ipe sizes larger than the exhaust pipe should be installed within 15 feet of he engine. We recommend any of the standard separators such as the Austin, or Crane, and they should be of the horizontal type.

The principle governing the action of all oil separators is exactly the ame as that of steam separators.

A baffle is so placed that the steam containing oil must strike it. The direction of the flow of the steam is changed and the oil is left on the baffle, from which it falls into the well below and is drained off. The separator, being two sizes larger than the exhaust pipe, greatly reduces the velocity of the exhaust steam passing through it, allowing the oil to drop out of the steam. Remember it is the velocity of the steam that holds the oil in suspension.

After the oil has been separated and has dropped into the well below the baffle, it is necessary to drain it off, without a reduced valve opening in the drain pipe, or waste of exhaust steam to the sewer or atmosphere.

The following is our recommendation for the proper draining of oil separators and is a method that has been in constant use at the largest and most modern plants for many years.

Please refer to the sketch on the opposite page and note the design of the drain pipe from the oil separator. It is known as a water-seal trap. Its advantages are numerous; chief of them is a full pipe size, unrestricted, inexpensive drain.

The column of water and oil in the water seal drain will not allow steam to pass through, but will drain all oil and water from the separator efficiently. When oil separators are of proper design and properly installed, and properly drained, all objectionable oil will be separated.

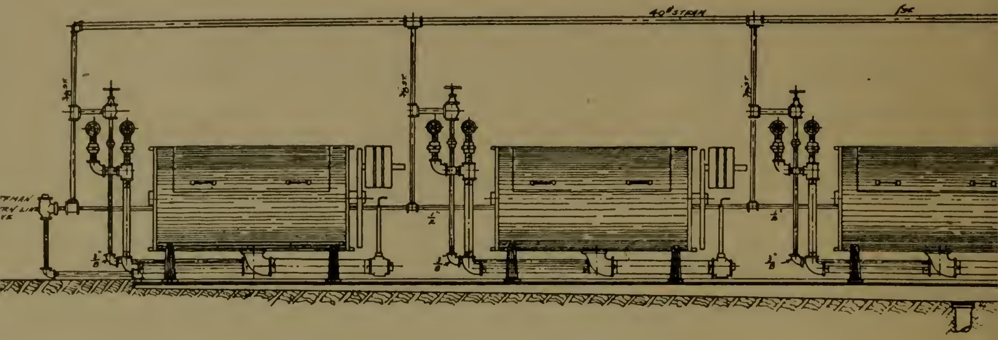
Cylinder oils are all compounded of mineral oils and animal fats. The animal oil will come through with the steam as an emulsion, and is in no wise objectionable. There should not be more than eight parts of oil to one million parts of water by weight left in the water after separation.

If, after installing an oil separator according to our directions, you experience any trouble, it will be due to oil of an inferior quality, which is highly volatile in its composition. Oil of a good quality, such as the Standard Oil Co.'s Capital Cylinder Oil, will not pass through an oil separator in a gaseous state, because it is not volatile in its composition.

The saving of more than 50,000 gallons of water each year, on a plant developing 50 H.P., added to the saving of washroom supplies because of the softening of the water, should make this article of great value to laundryowners.

We still be grateful for an opportunity to render special assistance on oil separation, as we know it will be productive of profitable results.

We know of one plant in the far West, where a stream of pure hot water runs into the sewer constantly and where, after being shown his loss, the owner refused to install an oil separator, because he claimed its cost was too great. We cannot build up the efficiency of our industry by being penny wise and pound foolish.



Proper Piping From the Steam Line to the Washing Machine

The large volume of steam usually supplied to Washing Machines not only causes a great waste of fuel, but decidedly shortens the life of the cylinder.

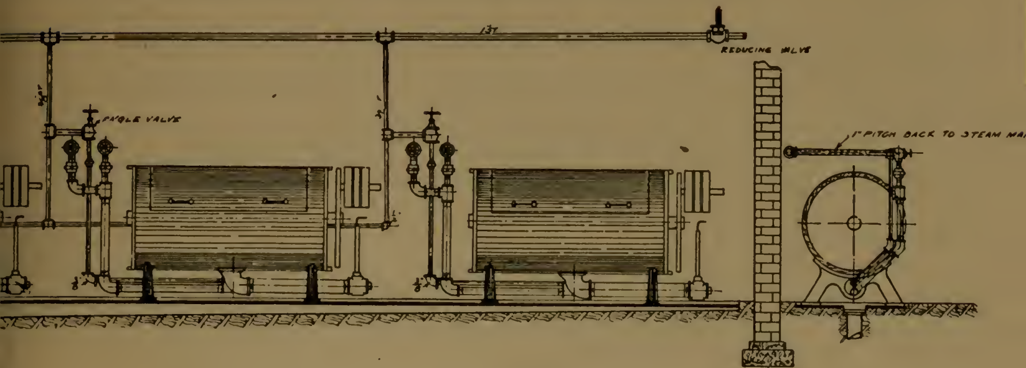
The velocity at forty pounds pressure, blowing into the washing machine, is very great, that is, if a one-half inch steam connection to the machine is used, and this size is usual. At the usual high velocity the cylinder is rapidly worn out, many cylinders having been cut nearly in two parts. There have been baffles used and other means have been adopted from time to time to deflect this steam from the cylinder The velocity is so great that even these baffles are soon ruined by the action of the steam at high velocity. We have seen many cylinders with iron bands around them to stop the cutting away of the wood by the steam.

From two to four inches of water at a wash is usual, and it will be readily seen that this low water cannot prevent the steam at high velocity from causing damage to a cylinder as well as wasting the steam. Much of the steam will escape out of the top of the machine, where it will cause further damage to walls and ceiling. This is, of course, objectionable as it is unsanitary to allow the walls and ceiling of the wash-room to become water soaked, and the help will experience discomfort as well.

Excess steam in the wooden washing machine has no doubt done more to shorten the life of the machine than the work it was built to do, while the manufacturer has been unduly censured because of the short life of the cylinder. One has but to visit a paper making plant and observe how pulp is made from wood by the use of steam to appreciate this fact.

We have designed a method of piping for the steam connections to washing machines, after a careful consideration of the steam required and the velocity needed to do quick, efficient work, and a cut of this new system appears in this paper. On examination of it, it will be noted that the lines are automatically drained of all condensation and that the steam for each machine is taken off the side of the steam line, an angle valve being used as a stop valve.

We have been asked many times by laundryowners to try and find the



reason for rust in the goods, as rust would be found in spite of every precaution taken, and the reason for this rust was not known.

With the usual method of steam piping to washing machines the stop valve is so placed that the line condensation will accumulate in the piping when the valve is closed. This condensation is at first void of impurities from the iron, forming rust, also this condensation, being in contact with the brass valve, will form a verdigris, if allowed to stand some time, and this rust with the verdigris and other dirt will be driven into the clothes at high velocity the first time the valve is opened.

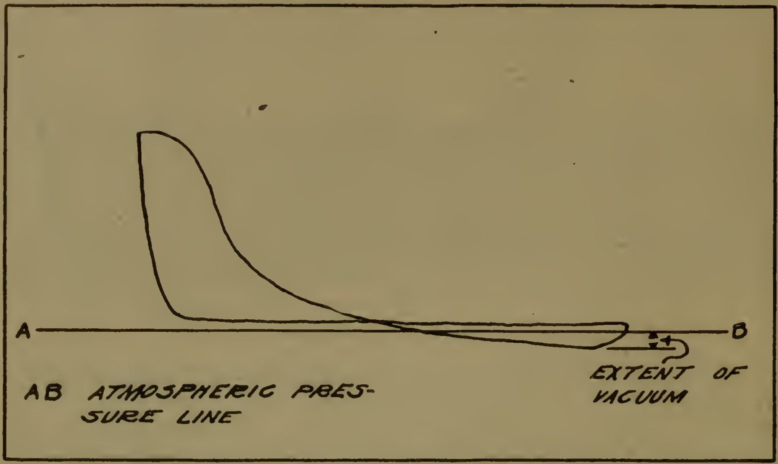
Steam is not used in washing machines at this day nearly so much as heretofore, and this, of course, causes the condensation to be greater and more injurious. How great the losses have been in plants due to this rust deposit, our readers are best able to judge.

We have found by actual tests that this system of piping will stop trouble from this source as well as to greatly cut down the waste of steam. The best pressure is found to be forty pounds, and the lines to each washing machine are but ⅜-inch in size. This will reduce the velocity of the steam just one-half. At this lower velocity the water in the machine will have double the time to absorb the steam, also the baffle used on the steam inlet in the machine will not be blown off or worn out. The small cost of pipe and valves needed to pipe up the system is, of course, a feature, and where trouble has been experienced with that devil of devils, *rust,* the installation of this system will be fully warranted.

On examination of the cut, descriptive of our design, it will be noted that a one-inch steam line is used to conduct steam at forty pounds pressure through a reducing valve to a ⅜-inch pipe run past each machine to a one-half inch main drain line. A small trap is used at the end of this drain line, which will automatically discharge the condensation, rust and other dirt into the trough under the machine. Steam for the machine is taken off the side of this ⅜-inch line, and if the stop valve used is of the angle type, nothing can accumulate on the pressure side of the valve, which could be blown into the machine when the valve is opened.

Careful study of the details in and about laundry plants will make a considerable reduction in money spent for coal, supplies, and damage, and we feel confident that this system will remove one great cause of grief.

Dry Steam to the Engine and the Prevention of Wrecks



Steam is used as a medium of heat transference from coal pile, oil barrel or gas to the cylinder of the engine, and great care should be taken in the sizing of the piping to the engine, the design of the line and water separation. The velocity of the steam to an engine is a great factor for its efficient operation.

During a survey of a very large plant, some years back, the chief engineer informed me that he intended to install an economizer at a cost installed of about $10,000, for the reason that there was excessive moisture in the steam delivered to the engine, also that there was a temperature drop of ten degrees Fahrenheit.

Upon examination, the velocity was found to be but two thousand feet per minute instead of seven thousand feet as it should be. The slow travel of the steam caused excessive line condensation, also the drop in temperature.

The chief engineer was advised to replace the six inch steam line to the engine with a two and one-half inch line, using a receiver steam separator as close to the throttle as possible.

This was done and the drop in temperature and excessive condensation overcome.

The cost of alteration was nothing, as the six inch piping taken out was put to other use at a profit, above that of the cost of the new line and the new receiver separator.

By a little reasoning ten thousand dollars was saved and more, for the cost of maintenance of economizers is high and the overall efficiency rather low.

All water entrained in the steam and carried into the cylinder is waste. One or two per cent is not bad, but, if ten or twelve per cent is carried over by the steam, the loss is considerable.

Water of condensation on the walls of an engine cylinder is one of the greatest losses for the reason that water is inert and has no expansive force.

But—If not one cent was saved, the use of a steam separator close to the throttle is most strongly recommended, for it will protect the engine in the event of priming or foaming and save the engine in the event of boiler flooding due to carelessness in allowing the water to get too high.

I wonder if any of my readers ever went through the experience of ruining an engine with water—I have—and that dull smashing jar will never be forgotten.

Aside from the danger to life, there is always the great expense of repair and the greater expense of lost time and lost customers.

Let us then give the steam separator some little time and sincere thought, and then make our plant safe by insuring it against "Water Slug" with a good steam separator.

As regards wrecking with water, there have been more engines wrecked by water entering the cylinder from the exhaust pipe than by water entering through a steam pipe.

When the engine is started in the morning there is no load. The automatic cut off shuts the steam off so early in the stroke that a partial vacuum is formed in the cylinder, which, pump-like in its action, will lift the water from the exhaust line into the cylinder. When the exhaust valve closes on the return stroke of the piston so as to cause compression, the water is trapped in the cylinder and, as it is not compressible, the engine is wrecked.

If the water is trapped in the crank end of the cylinder, the cross head will be broken and the out board bearing will be thrown out of line, often so far as to strip the coils from the armature, if it is a direct connected unit, also the crank shaft may be sprung. If in the head end of the cylinder, the cylinder head will be blown out, or the cylinder cracked or both and generally the crank pin loosened or sprung.

At night when the throttle is closed a vacuum will be formed in the cylinder, and, if there is water in the cylinder, it may be picked up causing a wrecked engine. The break will not be so serious, however, as the steam is shut off and the momentum has only to be contended with.

This latter wreck was caused at one of the best and most model plants in Chicago.

The cut on the opposite page is that of an indicator card, showing the vacuum caused by a very early cut-off, due to no load, while the engine was running idle after being started up.

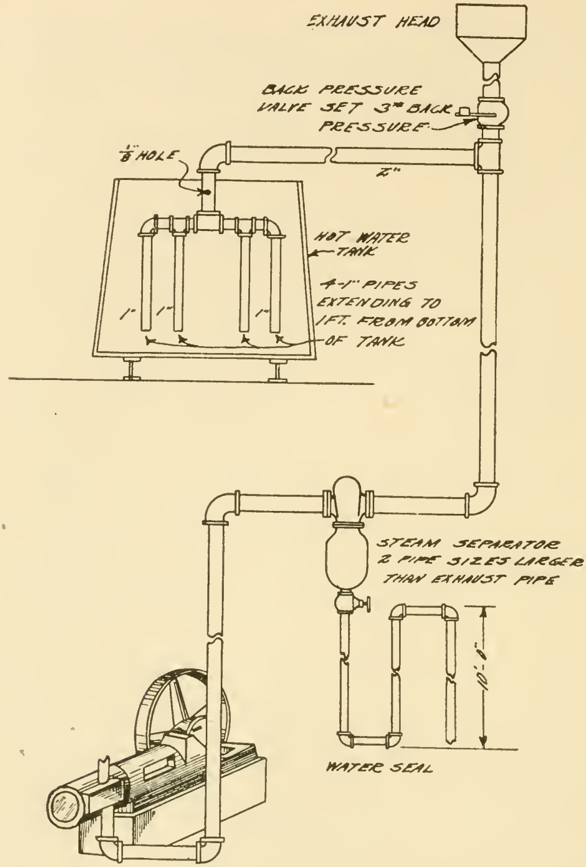
The remedy is—an ample drip in the lowest point of the exhaust line and a fixed rule that this drip be opened before the throttle valve is closed, and that the drip be kept open till the engine feels its load.

Now, just because you have been fortunate in not having your engine wrecked, do not neglect these important factors in the safe operation of your plant.

Go out to the plant and order a good steam separator installed at once and see that there is an ample drip at the lowest point of the exhaust line.

The old adage that an ounce of prevention is worth a pound of cure, will always prevail.

Hot Water Heating



Beyond any reasonable doubt the Troy Hot Water System will solve the problem of hot water in the laundry plant and further, as the hottest water is always being circulated through the piping right at the washer, there is always hot water available at the valve when the operator opens the valve.

At most all of the plants the hot water is so piped that the water cools off in the piping to such an extent that the water drawn into the machine is many degrees cooler than the water in the storage tank.

How this problem is met with by the Troy Hot Water System can be readily seen by carefully examining the circular descriptive of this system which we still gladly mail to you on request.

At most of the plants we survey we find that there is exhaust steam being wasted to the atmosphere and the system shown in this article has been designed with the idea of utilizing this wasted steam.

This system may be used in connection with your heater now in use or may be installed as an independent system. We have plants that heat their water to a temperature of more than 200 degrees, with this system.

This hot water system has many commendable features, one of them being the low cost of material and installation.

The illustration will serve to exemplify this fact as it shows the complete system with a few fittings and small amount of pipe.

The back pressure valve should be located just under the exhaust head, in a manner shown in the cut and it is to be loaded to three pounds.

Care should be taken that the Crane Oil Separator be installed correctly, also that the water sealed drain be installed, as in the illustration, as the proper operation of any oil separator depends on the proper draining of the water and oil.

When properly drained this separator will leave but one part of oil in seven million parts of water and there are many ice plants using steam after it has passed through this separator for the making of pure ice after the steam has been condensed.

The reason for having the separator larger than the exhaust piping is to lower the velocity of the steam as it strikes the baffle. The oil will then fall into the well below the separator from where it is drained into the sewer.

It is the velocity of the steam that causes the oil to stay entrained; lower this velocity and the oil will fall out of the steam as it strikes the baffle. The full open drain provided by the water seal will then keep the separator free of oil.

The weight of the water in the water seal outlet is greater than the pressure carried and for this reason the dirty oily water will be trained off without the loss of steam.

The exhaust steam is zero in hardness and has no impurities, so when it is brought in direct contact with the water in the tank the general hardness is reduced—another great feature.

Be sure that you do not neglect to bore the ⅛-inch hole where shown in the cut.

This hole acts as a vacuum breaker.

When the engine is shut down there will be a partial vacuum formed in the exhaust pipe which would cause the water to be syphoned into the exhaust system. If such a vacuum is formed the air will rush through the ⅛-inch hole breaking the vacuum and preventing this trouble.

This is of great importance.

The hot water tank is to be well insulated, so as to cut down the loss due to radiation, and there is to be a tight cover on the tank to cut down the loss due to evaporation.

This is one more help to the industry that will meet a long felt want as it will in many plants be the solution of hot water problems and we know of no more important need in any plant than an abundance of hot clean water.

Where there is no exhaust steam available, write to us and we will mail you a sketch of a noiseless hot water heater to be used with live steam. In this great industry of ours there is a growing need of attention to the little things as well as the big.

Leaks

Early in his business career one of America's greatest financiers was called before his board of directors and asked to explain the high operating costs.

A long report was expected by the directors, but try and imagine their surprise when the young man said, "Gentlemen, I have but three words to say; the ways and the means are up to you; *stop the leaks.*"

What a volume there is in those three words. Think of the report that America's waste will support Europe. Look all about you and note the waste that is daily ruining that efficiency which seems the very life of our industry, and then you *stop the leaks. We will help you.*

There are leaks everywhere and they are of many kinds. One would pass many hours in profitable thought on this subject viz: *Leaks.*

When we make surveys for general efficiency, these leaks are apparent everywhere, and when the owner's attention is called to them, it is often weeks before they are stopped.

At one plant which is operated ten hours each day, dozens of "small" leaks were found in the piping supplying the washing machines.

When we inquired of the washman how long the piping had been leaking, we were informed that the leaks had been there as long as he could remember.

The water from only two of the leaks was caught in pails for five minutes and two gallons were collected, making three hundred gallons in one day, seven thousand two hundred gallons in one month,, or 60,000 pounds.

The average temperature of the city water supply was 60 degrees Fahr. The average temperature of the hot water at the plant was 200 degrees Fahr. It requires 140 B.T.U., which means 140 heat units, to heat one pound of water from 60 degrees Fahr. to 200 degrees Fahr.

They were using a good grade of coal at that plant, which averaged 13,000 B.T.U. per pound of coal.

Assuming the furnace efficiency of their plant to have been 50%, the heat value per pound of coal was 6,500 B.T.U.

Thus we see that by dividing 6,500 B.T.U. (the total heat in one pound of coal), by 140 B.T.U., the amount required to raise one pound of water from 60 degrees Fahr. to 200 degrees Fahr., one pound of coal would heat 46 pounds of water to 200 degrees Fahr.

We have shown that the water wasted in one month was 60,000 pounds, so by again dividing, we find, $\frac{60,000}{46} = 1,304$ pounds of coal wasted from only two of the many leaks.

Coal cost at this plant was $6.00 per ton, which makes the cost for the two leaks figured, more than $3.00.

The water cost was seven cents per thousand gallons, making an added waste in money of forty-nine cents for the 7,200 gallons wasted, or a total waste for the two leaks of $3.49.

The leaks measured were about one-twentieth of the total leaks at this plant, which makes a total loss of $69.80 per month. Give this a thought as you read, Mr. Plant Owner, for you are *the man who pays,* in the beginning, then the customer, then the industry; in the end, what?

Were they careless, did they realize their waste? *You say.*

We again call your attention to the waste or cost of one-half inch of total steam leaks, that has been figured for your aid, at 100 pounds steam pressure as that pressure is the average carried at laundry plants.

Total leaks.	Pounds of steam wasted in one month.	Cost of coal per month.
½″	835,000	$184.00

Cost of water at 10c per M. gallons.	Total cost per month of coal and water.
$10.00	$194.00

Total waste in twelve months, $2,330.00, which is 6% on an investment of $38,800.00. Can any plant stand that or any part of it?

We do not mean to say that there are ½ inch of total steam leaks on any plant, but give these figures, so that your thought of the cost of steam leaks will make you see that leaks of any kind in the steam or water piping are one unpardonable sin at your plants.

The figures on the cost of steam leaks are based on a coal cost of but $3.50 per ton, the coal having a heat value of 13,000 B.T.U. per pound, with an evaporation of eight pounds of water per pound of coal from and at 200 degrees Fahr. Water cost is based on 10c per thousand gallons.

Go right out into your plant and look around you and if you do not find leaks in several of the departments, you have one plant in ten thousand.

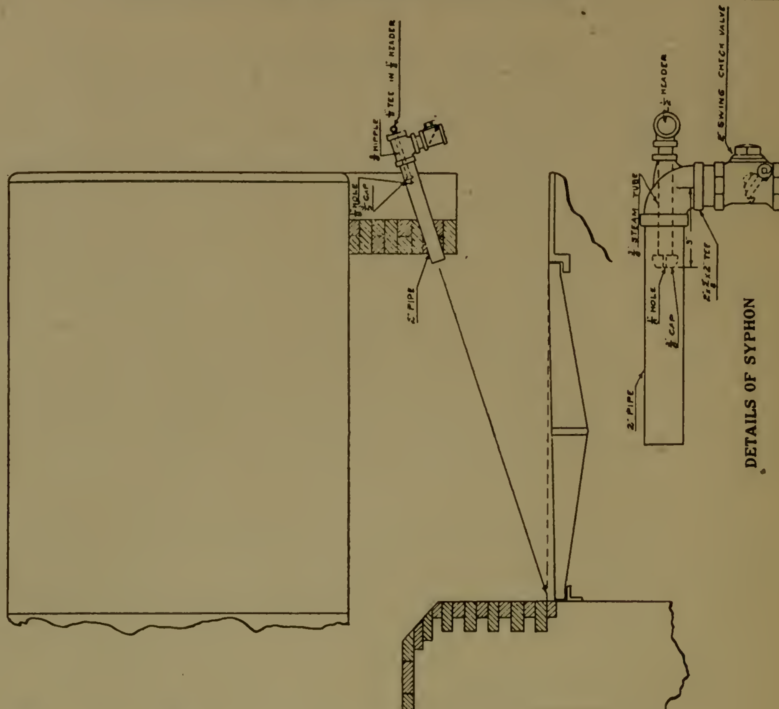
Make this your thought:

The hiss of steam leaks here and there,
Are reasons for the greatest care.

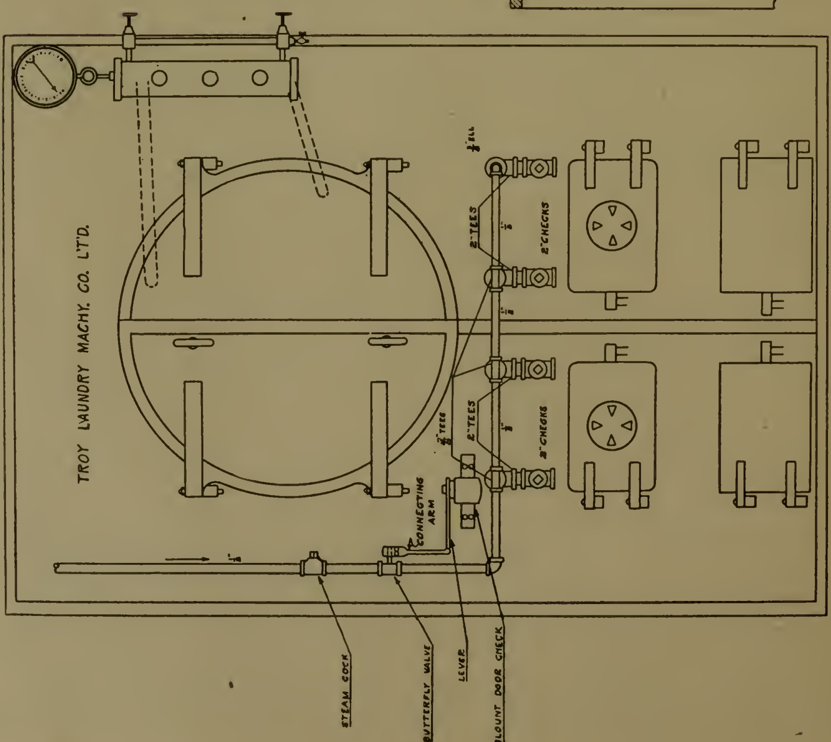
The excessive use of steam in the washers is a great waste of steam and will not only pile up your plant waste as figured above, but will pulp your washer cylinders and cause a further waste of supplies.

Let us try and remember the fellow that kept his eyes on the clouds and stumbled over a brick.

Inspect your plant at once. ***Stop the leaks.***



DETAILS OF SYPHON



AUTOMATIC SMOKE CONSUMER

A Device For the Prevention of Smoke

Absolute cleanliness should be the aim of all laundryowners; everything in and about the plant should be clean. The laundry and cleanliness should be synonymous in the minds of your customers.

A chimney belching forth black smoke is a mighty poor advertisement for any laundry. Add to this the loss suffered in the plant due to soot getting on the goods, and there is reason enough for making every effort to prevent smoke.

The customers in the vicinity of the plant will object to smoke and the good feeling that brings in business will be lacking.

Smoke is a waste, for the reason that it is caused by incomplete combustion. When green coal is fired, it heats with great rapidity and from twenty to forty per cent of the combustible matter is distilled off in the form of gases and tar vapor.

From two to six minutes are required to consume the gases, completing the process of distillation; the heavier the coal is fired, the more volatile matter is distilled off.

Free oxygen in quantities of from fifteen to twenty times the weight of the gases is required for complete combustion, thus preventing the formation of smoke.

The distillation is great at first and becomes less and less as the coal ignites; for this reason the air should be admitted over the fire in large volume at first and gradually reduced, being entirely cut off at the time the distillation stops.

It has been said that such regulation of air over the fire is impossible, and it was with the idea of actually regulating this air over the fire that this device was designed.

No device is a smoke consumer in the fullest sense of the term, for the reason that after the smoke has been once formed it is not possible to consume it. Our device prevents the formation of smoke for the reason that the smoke-forming matter is consumed while it is red hot in the flame, before it has been turned into smoke, because of incomplete mixing of the air and the carbons.

The reason why most smoke devices fail is due to the fact that the air admitted over the fire has a tendency to travel parallel to the gases without mixing with them. If smoke is to be prevented, there must be a complete mixing of the air and the gases.

The detailed drawing of the smoke device should enable any one to make the installation. It is simple, easily understood, semi-automatic and low in cost.

The drawing is for a boiler of 150 H.P. and the sizes given are for a boiler of that size. For boilers of 100 to 125 H.P., use 1½ in. pipe and swing check valves, for the nozzles; for boilers of 75 to 90 H.P. use 1¼ in. pipe and swing check valves; for boilers of less than 75 H.P. use 1 in. pipe and swing check valves, for the nozzles; and a $\frac{1}{16}$ in. hole in the end of the cap instead of ⅛ in.

You will note the steam line to the header supplying steam to the nozzles has a steam cock and a butterfly valve, the latter connected to the Blount door check fastened to the boiler front.

ADJUSTMENT AND OPERATION

Fire the usual amount of coal, and, when the stack is smoking, open the steam cock just enough to stop the smoke. While this is being done, the lever of the door check must be held back so as to keep the butterfly valve wide open. As soon as the steam cock is adjusted set the door check so it will close the butterfly valve by the time the smoke-forming matter is consumed.

After the device is properly adjusted, try and fire the same amount of coal each time and the result will be a clean stack.

As soon as the coal has been fired, pull the lever of the door check as far as it will travel and then release it. The door check will close off the butterfly valve in the time you adjust it to close, and in so doing will gradually reduce the amount of air flowing through the steam jets. The flow of the steam through the steam jets is what forces the air into the furnace and, as it is gradually reduced, the amount of air becomes less and less until it is entirely cut off at the time the distillation has stopped.

The swing check valves will then close off, preventing the admission of air over the fire at a time when it would cause a loss.

The thorough mixing of the air and volatile gases is caused by the velocity of the air as it leaves the nozzle. The nozzles are all aimed at the junction of the bridge wall and the grate, thus overcoming the tendency of the air and gases to travel parallel lines.

The steam not only induces the flow of air through the nozzle, but it heats the air as well. Also the steam is changed to hydro-carbon gas by the heat of the furnace and it in turn increases the temperature of the furnace.

Smoke is stopped by the use of this device and it also effects a saving in coal.

We must all be a unit in the effort to conserve the nation's coal supply, and for this reason we are glad to offer this device to the trade just at this time.

Care and Maintenance of Belting

The importance of attention to the belting in laundry plants should be realized if the transmission of power is to be economical.

In by far the majority of laundry plants belts are the means of transmitting power from the fly-wheel to the machinery and many mistakes are made which are costly.

Power is transmitted from one pulley to another by the friction of the belt and the arch of contact between the belt and the pulley determines what that friction is.

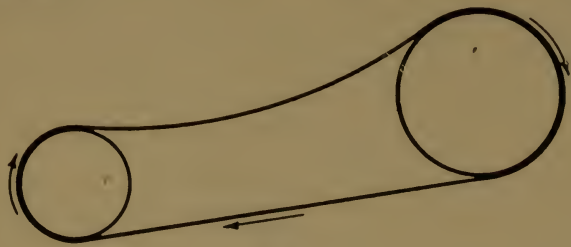


FIG. A

In figure "A", a belt is shown running in the proper direction and the belt is in the good condition which allows a good contact with the pulleys.

If the belt was run in the opposite direction, the "pulling side" would hang away from the pulleys, the contact with pullys would be much less; the consequent power loss by slipping would be costly. The belt would have to be kept tight on the pulleys.and the life of the belt would be shortened. Attention to the direction of the travel of the belting when installing the machinery will materially decrease the loss of power by slippage and the belting will have a longer life. Belts used on washers and dryroom tumblers are shifted from one pulley to another to change the direction of rotation and must be tight to be shifted.

Single belts should always be run with the hair side, or the smooth side, to the pulley, as this side will give the best friction and the trouble due to air between the belt and the pulley will be lessened.

The greatest loss by slippage when the belt is running in the proper direction is due to air between the belt and pulley. Perforated belts have been designed to offset this trouble and some of these belts have been a success.

There are lint and moisture in laundry plants and this combination of evils will cause the belting to become dirty also will soon cause the belting to collect dust. This will keep down the pull of the belt.

The pores in the leather are alternately opened and closed as the belt travels from the tight to the loose side and dust which gets into the pores will cut and grind the leather ruining the friction of the belt and causing the surface to peel off. To clean off dirt from the friction side of the belt, one part of benzine to two parts of turpentine will be found very efficient; do not use carelessly; put a little of the solution on a rag, and clean a three foot section at a time; be sure to wipe the belt dry. After thoroughly cleaning the belt apply neat's-foot oil, using an oil can for the purposes; and do this while the belt is running slowly. Apply the oil in the center of the belt is the contact with the pulley will insure an even distribution. This should be done frequently so as to prevent the belt drying out and cracking. It also will prevent moisture from rotting the belt. No other belt dressing vill be needed.

Belt dressing should not be used except in extreme cases, as it is a nakeshift way of handling belts. And it will soon ruin the friction.

When putting on a new belt always examine the belt carefully so as o have the belt travel with the laps and not against them. Many manufacturers have an arrow stamped on the belt to indicate the direction of ravel, and this is a very good idea. If the belt is not so marked a careful examination of any one of the laps will show the direction of travel, as all belts have the laps in the same direction.

There are three weights of belts used in laundry plants, viz: single, ight double and double belts. The single belting is of course less in first cost but the light double will prove the most serviceable and the cheapest n the long run.

Various methods are used to fasten the ends of the belts together, but he glued lap or the endless joint is the best. When holes are punched in he belt for lacing the belt is weakened from 15 to 25 per cent, depending on the size of the holes, and this joint always breaks when the machine is nost needed. Figures "1" and "2" will show how the endless lap or joint s made. The tools used are called a scarfer, scraper, and finger steel, for harpening the scraper, also a small square, screw driver and hammer; he glue is heated in a jacketed glue pot and is applied with a brush when hot. The belt should be warm and care taken not to let the glue chill.

FIG. 1

Fig. 1. Lap for single belts.

When the length of the belt is taken, add four inches for 2 and 2½-inch belts, as four inches is the length of lap for these sizes; add six inches for 4-inch belts and for 6-inch belts and larger add 10 inches.

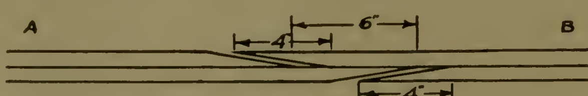
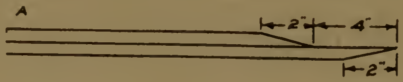


FIG. 2

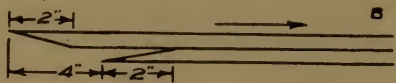
Fig. 2. For light double, and double belts.

To make the single lap, first place the square across the belt, and scrape a part of the surface of the belt away. This leaves a straight line to start from with the scarfer, which is a rounded draw-knife. Cut the leather away until the wedge shape shown in the sketch is had; then scrape the lap until it is even; next make the lap on the opposite end of the belt and, when both laps are laid together, they must be of the same thickness as the belt. To make the double lap, first cut each end of the belt square, then make lap "A" as follows: A six inch lap is to be made; first split one end of the belt four inches back from the end, with a screw-driver, and cut a four-inch piece off on one side, then measure back six inches from the end and square a line across the face of the belt with the square and scraper; next scarf down the back end of the lap.

Then turn the belt over and make the 2-inch lap on the other side. After this is done, scrape the face of the lap until it is even. Then make



the other end of the lap thus: split the belt six inches back from the end and lay this end down beside the part of the lap already made, so as to be sure and not cut off the 4-inch piece on the wrong side. Then shape this part of the lap so the other end will fit into it and when laid together they will be the same thickness as the belt; when this end of the lap is done it will look thus:



and the completed joint will look thus:

The arrow shows the direction of travel of the lap.

When the belt has stretched and is to be tightened, split the joint very carefully with a screw-driver and cut from one end only the amount necessary and, after scraping off the old glue, cut the end into shape again.

To glue the lap, clamp the ends on a board, so they will lay exactly even and after applying the glue, hammer the joint lightly and rub it smooth with the face of a hammer, then let the joint stand until set.

The following formula is one of the best belt cements and will be found satisfactory: To equal parts of common glue, and best American isinglass, add enough water containing three spoonfuls of carbolic acid to cover, and let stand ten hours; then bring to the boiling point and add enough pure tannin to make a ropey mass; apply hot after thinning to the consistency of syrup. Keep in a cool place and heat in a jacketed glue pot.

Isinglass is gelatine glue. It is often used as term describing mica.

The Evaporation Test—Chapter One

The evaporation test is a method used to find the heat value of fuel, be it coal, oil, gas, or wood, so as to *know* the true manufacturing costs.

There is a great difference in the heat value of fuel, also a great difference in the care and management of the boilers by the men in charge.

Some engineers will, by the proper management of the boiler and the correct understanding of combustion, get far more from a given fuel than others.

It is to call attention to this fact that this article is written for *you*.

Are you the man who cares?

When boilers are so managed that there is from 150% to 200% excess air admitted, the valuable heat of the fuel will be lost up the stack, also the accumulation of soot and scale will lower the overall efficiency and greatly increase the cost of plant operation.

Are you *the man who cares?* If so, let there be a means at your plant whereby the daily evaporation of water is *known*, as that sure method will serve as a check on the ability shown by your engineer in the care and management of your boiler, the handling of your Fuel = *Your dollars.*

Do you know what part of your fuel is being wasted up the stack?

Have you ever examined the ash pile and noted the display of waste?

We are sure you care and we want to help you.

Volumes have been written for you; an entire library might be devoted to the subject of "The Economical Production of Power," yet, when it is all simmered down to Brass Tacks, it is *what can you give me in power for one pound of coal,* that tells the whole story.

When evaporation tests are made, the amount of water evaporated into steam in your boilers per pound of coal is found, by metering the total water put into the boiler and dividing the total amount, in pounds, by the total pounds of coal burned in a certain period of time.

The value of the test is that it will show the quality of fuel, the relative value of various coals, the care taken in the general management of the boiler, as to keeping it clean, damper regulation, firing, and air infiltration. Also, knowing the total pounds of steam developed by the boiler, a check may be made on the general operation of the plant, as to the use of the steam after it is developed.

Remember that the evaporation of one pound of water means the production of one pound of steam.

Just at this time when the men in charge of the industry are so greatly concerned as to costs, is the time to know the cost of the production of steam, as no cost determination can be truly accurate, that fails to show the cost of the steam used in developing power, also the cost of the steam used in your laundering processes.

What portion of your total steam are you using in your washers?

It is probably very great.

What portion in your engine? It may be "blowing through" or in bad shape.

Are you getting the full benefit of the very valuable by-product of the heat in your condensation?

Are your boilers being properly handled as to combustion, cleanness and general maintenance?

The Evaporation Test is the real base of all cost determination in the power plant, it is the fundamental basis of all tests.

This subject is one of great importance and will be taken up with you in two articles. All preceding papers have led up to this subject. Carefully read them again, then get your plant in condition to start this test.

As members of an industry that has been given national prominence, let us not be backward in the practice of efficiency at our plants; let us come to a fixed determination to get our plants in such shape that we can keep them in a state of true efficiency.

The Evaporation Test—Chapter Two

When a mine is opened the coal is tested for heat values as compared with other coals on the market and a price set on the coal in proportion to its tested values.

Soft coal lies in the mine in stratas, with clay bottom, coal center, and slate top.

The value of the coal all depends on how carefully the coal is mined so as to free it of the clay and slate. If there is slate or clay in any quantity it will naturally reduce the heat value of the coal. The heat value is figured as to the number of British Thermal Units, (always written B.T.U.) per pound of coal.

The number of B.T.U. of heat in your coal is what its value is based on.

You may be sure that, if you have no way of finding exactly what the coal delivered at your plant is worth in heat value, many loads will fall short of full value and your plant operation costs will go up.

Further: how can you know the power costs, if you do not know the cost of producing steam?

All that may be said or written for you on the subject of engineering, simmered down to brass tacks, is simply, what can you give me in power per pound of coal consumed?

A pound of water evaporated in the boiler in a pound of steam produced. Coal, oil, gas or wood is burned in producing steam and its heat value is based on how many pounds of water are evaporated per pound of fuel burned.

This is known as The Evaporation Test.

Knowing the pounds of steam produced by the consumption of one pound of coal, oil, gas or wood, it is easy to find the comparative value of various fuels.

Then, too, when you weigh the condensation from a certain process in the laundry plant, it will show you the actual cost of process operation in the plant, as one pound of condensation represents the use of one pound of steam.

For instance, if in ironing a lot of goods our condensation weight is 1,800 pounds, we know that the machine has consumed 1,800 pounds of steam in doing that lot of goods.

If our evaporation tests have shown us that we produce eight pounds of steam per pound of coal consumed, we know that we have burned 225 pounds of coal in ironing that lot of goods and the cost of this coal added to the cost per H.P. used in driving the machine will give the actual cost in power and process steam to iron that lot of goods.

If the machine has required five H.P. to drive it, that would mean fifty H.P. hours in that lot of goods.

A H.P. of work is the standard consumption of thirty pounds of steam —then fifty H.P. x thirty = 1,500 pounds of steam used in driving the machine. Fifteen hundred pounds of steam used in driving the machine divided by eight will show us that we have used up 187.5 pounds of coal consumed in driving the machine; this added to the coal used in producing the steam used in the process work will make a total of 412 pounds of coal to iron.

From this we trust that you will see the need of the evaporation test as it will show you the actual fuel based on B.T.U. of heat, and thus enable you to buy fuel wisely. Also your manufacturing costs may be figured accurately.

Evaporation tests are made by very carefully weighing the total water evaporated during a certain period of time and dividing this weight of water by the total coal consumed during the test.

Fasten a piece of string around the glass exactly at the water level in the glass, at the time the test is started, and at the finish of the test be sure that the water is exactly at the string.

Then carefully meter the water evaporated during a given period of time in pound, and divide by the coal used during the test, in pounds. This will give you the cost to produce one pound of steam and the actual value of the fuel.

One sure method to be used at our laundry plants, where the total water used in the boiler is handled by a direct return trap, is to install a valve in the discharge from the trap, so that the discharge from ten trap operations may run into a barrel. Then divide the weight of the amount of water by ten and you will have the weight of water handled by the trap each operation.

Next install a counter so that the number of operations may be counted accurately and automatically. Then multiply the number of trap operations by the pounds of water handled each operation and you will have the total water evaporated during the test.

Carefully weigh the coal burned during the test, then divide the total water by the total coal and that will give you the pounds of water evaporated by each pound of coal, also the pounds of steam produced.

Know the actual heat value of the fuel you are paying for.

Let us also realize the need of knowing our actual manufacturing costs, so as to make our cost system accurate by having it show the cost of producing steam for power and process.

Plant managers in most all other industries know what the power cost is on every thing produced in the plant.

We are manufacturers and it is time, just now, to get down to cases on the economical production of our output.

Knowing the cost to produce, we can readily find whether it is too great or not and can then make the needed alterations that are bound to improve our industry.

We can make money on our savings in the plant, also it is a certainty that we must get this great industry of ours on an efficiency basis.

The way to do this—is to *know* what the value of every thing we purchase is, also to know that it is used by the operators intelligently.

Today we found a plant that has a sure saving possibility of $1,800.00 a year. This saving made will represent an income of 6% on an investment of $30,000.00. The cost of the material to effect this saving is $950.00, plus the determination on the part of The Man Who Cares—He is "going to it."

Why do you not also take advantage of the service we are willing and take pleasure in giving you, for the furtherance of this industry which can go but two ways, *up and on to better general conditions,* or *backward to a "brute of a game?"*

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