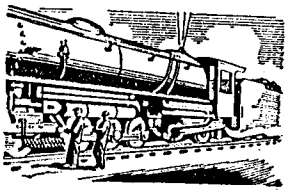
Technical Department



If There's No Water Kill the Fire

Illustrations Furnished Through Courtesy of the Interstate Commerce Commission

By J. E. BJORKHOLM*
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"IT WAS found that the accident was caused by overheating of the crown sheet due to low water." This statement is usually the conclusion reached by the inspectors of the Interstate Commerce Commission Bureau of Locomotive Inspection who are always called upon to investigate and report their findings in connection with these accidents, commonly referred to as boiler explosions or crown sheet failures.

The whys and the wherefores, however, in most instances, remain a mystery, as those who could throw some light on the subject usually become fatalities and only through circumstantial evidence painstakingly gathered by these trained investigators can some probable cause be construed. In many instances probable contributing factors are mentioned; in others, no such factors are apparent and the boiler and all its appurtenances are found to be in good condition—but still the discolored area of the crown sheet gives indisputable evidence as to the direct cause of the accident.

Through its activities the Bureau of Locomotive Inspection has done excellent work since it was established in reducing these accidents. The railroads likewise have endeavored, through improved material, certain safety devices, better design and maintenance practices and safety first activities, to prevent these catastrophies which leave in their wake death, sorrow and painful injuries that frequently result in life-long disabilities, to say nothing about the usually large material loss involved; yet they occur.

What is the answer? In this article the writer will attempt to approach the subject from an angle which in his opinion has heretofore not been fully explored. It is hoped that the expressions herein set forth may cause serious thought and reflection so that in the end they may bring forth action tending to reduce, if not entirely eliminate, these wholly unnecessary calamities.

The matter of boiler explosions is a comprehensive subject. Numerous and voluminous reports have been written and much costly research has been undertaken, and I believe it is generally recognized that, from the point of view of proper material, adequate construction and dependable appurtenances, the boiler as a pressure vessel is surrounded by the necessary factors of safety if properly operated. The human element entering into the question, however, has not in my opinion been given the consideration it deserves and that feature will be discussed in this article.

I think it is universally accepted that few other types of boilers are subject to the abuse and difficulties surrounding the operation of locomotive boilers. It is to the everlasting credit of the men who design and build them, to the men who maintain them and to the men who operate them that, with few excep-

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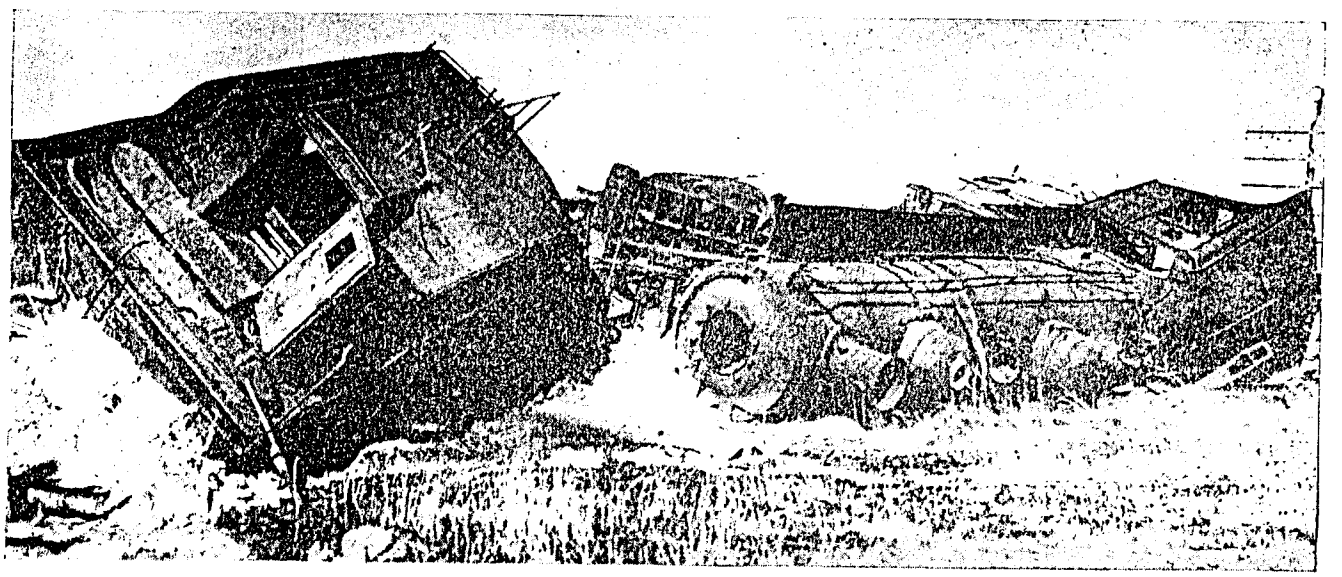


One employe was fatally injured and two employes were seriously injured in this accident caused by overheating of the crown sheet due to low water. The explosion occurred while the locomotive was hauling a troop train at an estimated speed of 50 miles per hour.

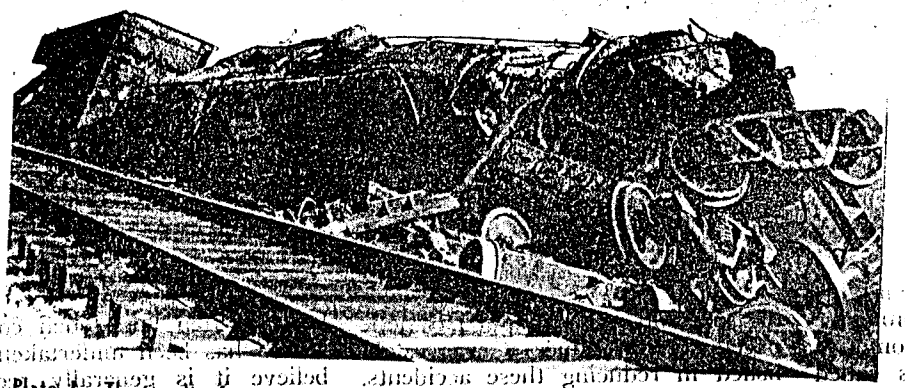


Plate 1. The result of an explosion caused by overheating of the firebox sheets due to foaming boiler water. Two employes were killed and one employe was seriously injured in this accident. The force of the explosion lifted the rear end of the locomotive without the trailing truck, together with the cast steel tender frame which pulled from under them water and oil tanks, and hurled it over in a complete somersault. Parts were blown off and scattered over a radius of 600 feet. The locomotive was hauling an oil train at an estimated speed of 15 miles per hour at the time of explosion.

tions, they function remarkably well.

Many factors, however, conspire to cause difficulties occasionally in the proper maintenance of a safe water level, such as inferior coal, leaky flues, defective valve and cylinder packing, mechanical troubles with water pumps, injectors and stokers, foreign matter in the coal, boilers foaming, etc., resulting in difficulties in maintaining the required steam pressure and causing the locomotive crew to "trade water for steam," to use a common expression. These are the usual factors that eventually lead to disaster. None of them, however, provides any reasonable excuse for permitting the water to reach an unsafe level and result in an accident. However, engineers and firemen are willing at times to take chances with low water—even though as experienced men they are, or at least should be, fully aware that in doing so they are playing with dynamite.

There is only one thing to do when the water begins to play "peek-a-boo" in the basement instead of being in the second or third story of the water glass, and that is to pay strict attention to the lower gage cock. When the water is no longer in evidence the fire must be extinguished with the first means at hand; if the water bucket or a hose is not available the fire can always be dumped into the ash pan or some other means resorted to. The result may be a temporary tie-up of the railroad, but it is far better for the engineman to say good morning to his superintendent or master mechanic and explain what occurred than be called upon to render an account of his earthly doings to St. Peter.

It is an old saying that familiarity breeds contempt. This is applicable to many enginemen. In their service as such, in many cases stretching over scores of years, they have taken a lot of chances with low water and, unlike betting on the horses, in most cases they have won but eventually the time comes when they take one chance too many. This is no criticism of the enginemen. It is only a consequence, especially after their having operated a locomotive for years, often perhaps under trying conditions. There have been many occasions when things looked pretty dark but finally they succeeded in correcting whatever trouble was confronting them and the situation was cleared up.

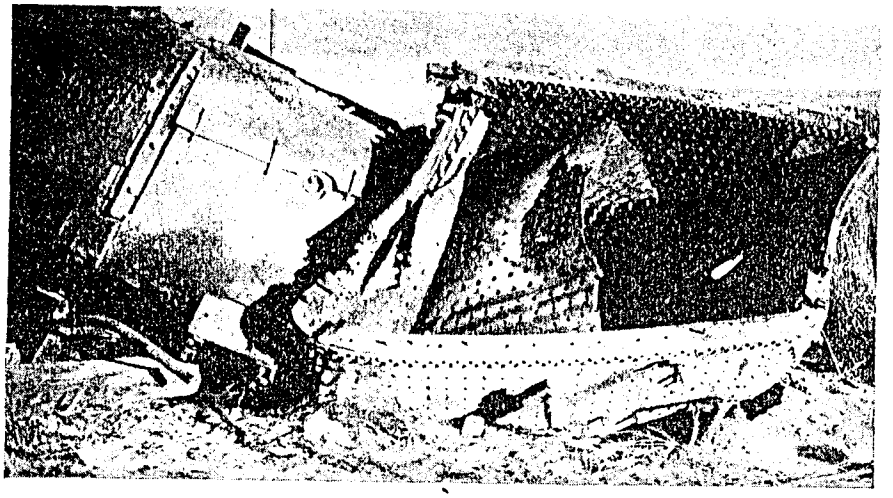
This, together with the ingrained pride of most enginemen to bring their trains in on time and the apathy of most of them to make a statement or, as they usually express it, "to write a letter," causes them to try to keep going even when the odds seem overwhelmingly against them. In most instances they win, in many others they lose; but in some cases they are not left alive to tell the story of what happened. In this connection, so that I may be properly understood, may I say that I have the highest regard for enginemen who are resourceful and willing to take a chance—except when taking a chance with low water.

It is not the intention in the foregoing to infer that the cause of boiler explosions in all cases is due to enginemen permitting the water to reach an unsafe level and failing to take the only precaution that can be taken under the circumstances. I have merely aimed to elaborate on a cause which in my opinion has not been given the important attention it deserves. I do mean, however, that in all the ramifications incidental to this type of accident the contribution made towards this unfortunate record altogether too frequently is due to the water being permitted, for various reasons, to reach an unsafe level without the crew in charge resorting to the only safe preventive, and instead taking a chance beyond a safe margin.

If the lesson can be brought home to enginemen never to take undue chances with low water, that it is far better to extinguish the fire prematurely on a score of engines rather than wait until it is too late on one [illegible] entirely satisfied that the conclusions reached at the beginning of this article will be published less frequently by the Interstate Commerce Commission.

On the Milwaukee the mechanical management for a period of years has resorted to making urgent appeals to enginemen in the strongest possible terms never to take a chance with low water, pointing out to them that if necessary, in order to be safe, it is better to tie up the railroad than ever take an undue chance with the water level — thus always playing safe, and by a large margin. Frequent educational notices or bulletins are posted on bulletin boards reserved exclusively for this purpose, thus not permitting notices of this nature to become mixed with bulletins on various other subjects, but to stand alone and conspicuous in their importance. In them attention is usually called to accidents or difficulties due to low water, whether on the home property or on other carriers, pointing out briefly the causes and consequences and

Plate 2. Cars of burning gasoline ignited as a result of the explosion of the boiler shown in Plate 1.



The result of an explosion caused by overheating of the crown sheet due to low water; one employe was killed and two employes were seriously injured in this accident. The explosion occurred while the locomotive was standing at a water crane; it had previously been cut off from a freight train about 4½ miles from the water crane when it was found that it had run out of water.

then making an urgent appeal, never to be guilty of operating a locomotive unless it is positively known that the water level is safe. Locomotive crews are instructed in plain and understandable language to extinguish the fire if in doubt, even though it may mean temporarily tying up the railroad. A few quotations are as follows:

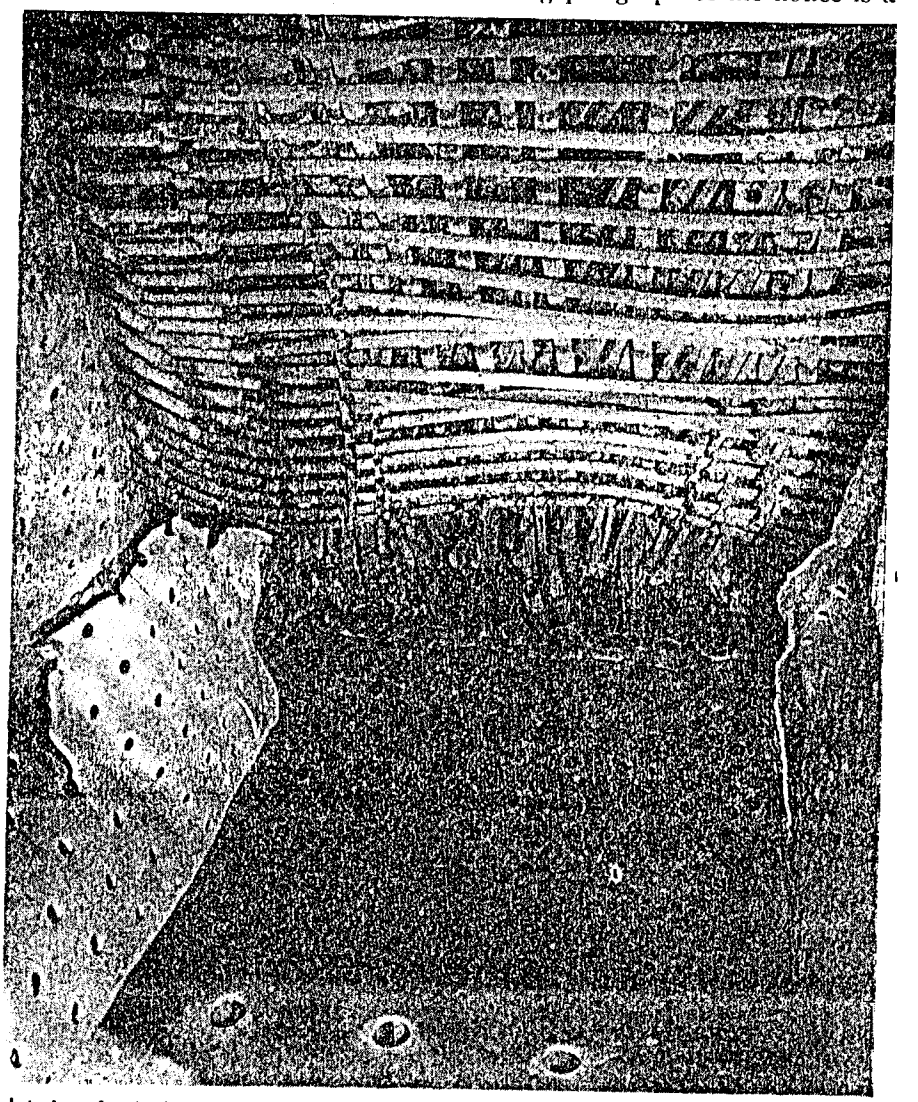
"There is nothing new that I can say that has not already been said about the danger of low water. All I can do is to repeat what I have previously said. Don't take any chances with the water in the boiler. Check the water glass, water column and gage cocks together with the firebox and injectors or feedwater pumps when taking charge of an engine and remember that water is consumed at a rapid rate when a locomotive is working. Injectors and pumps might give trouble at times and if they do and the water gets low in the boiler you should extinguish the fire before you permit the water to reach a dangerous level, even though you may tie up the railroad. A satisfactory explanation of the trouble with which you may have been confronted will not result in any criticism, but if you fail to take these precautions the most serious consequences usually are the result."

"Again let me say, don't take any chances with low water. If you have trouble keeping a safe water level take the precaution of extinguishing the fire before it is too late. If such precaution will cause any delay remember that it is better to have a delay on the side of safety than have a more serious delay a little later, and perhaps several fatalities with mourning families and friends."

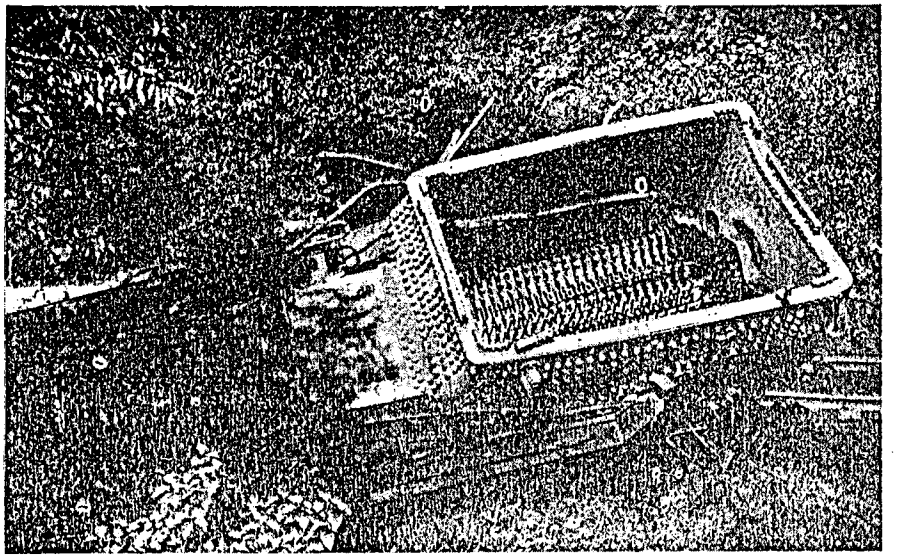
"In this particular instance the trouble was due to the fireman forgetting that he had opened the ash pan swipes after he had shaken the grates and after he noticed that the water was receding rapidly in the boiler he went over to the engineer's side and put on the engineer's injector while the engineer was busy looking ahead for signals, but did not take the trouble to satisfy himself whether the injector went to work or not."

"A reminder: Don't overlook checking the water level in the boiler frequently by trying the gage cocks, blowing out water glasses and water columns and seeing that water glass valves are wide open."

I have always felt that the unfortunate experience of one might be a wholesome lesson to someone else and for that reason we publish, through the medium of these educational notices, unusual locomotive failures or accidents, without identifying the trains, locomotives or locomotive crews. It is our hope that in so doing others may profit. No matter what the subject may be, the closing paragraph of the notice is a



Interior of a firebox after an explosion caused by overheating of crown sheet due to low water. Three employes were killed and one employe and one non-employe were injured in this accident.



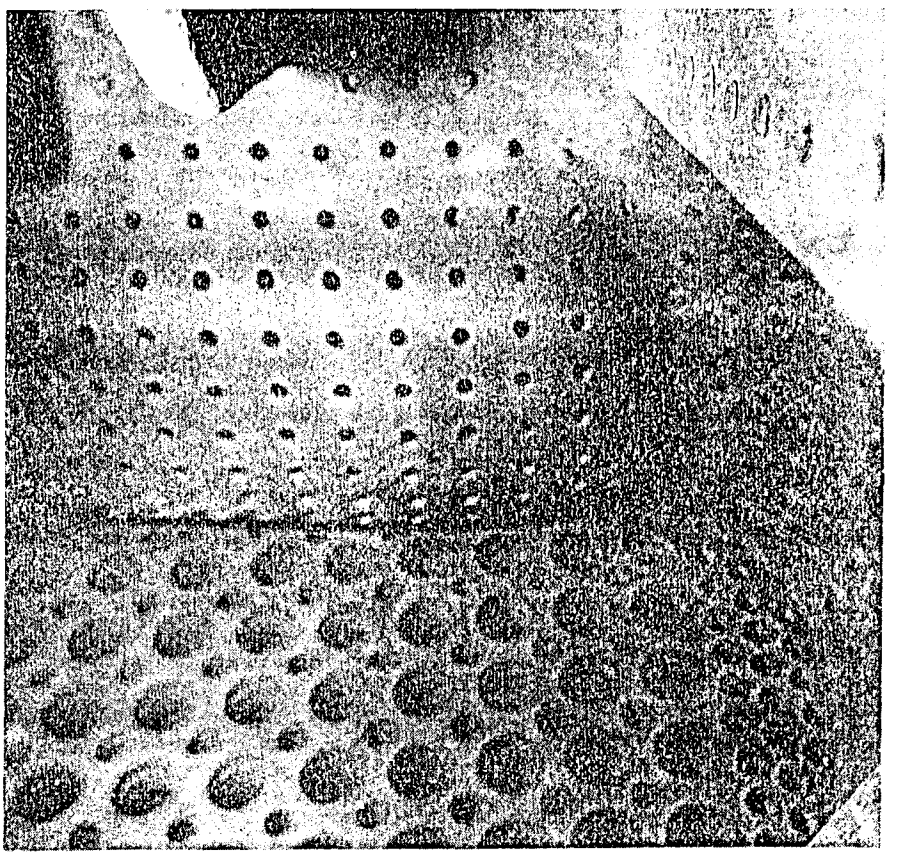
Explosion caused by overheating of crown sheet due to low water. The boiler exploded while the locomotive was the second engine of a doubleheader hauling a freight train at an estimated speed of 15 miles per hour. The engineer was killed instantly, the fireman died about 6 hours after the accident, and the engineer and fireman of the leading locomotive, and the head brakeman who was riding in the cab of the leading locomotive, were seriously injured.

reminder in bold type never to take a chance with low water; each time somewhat different in language but in substance always the same.

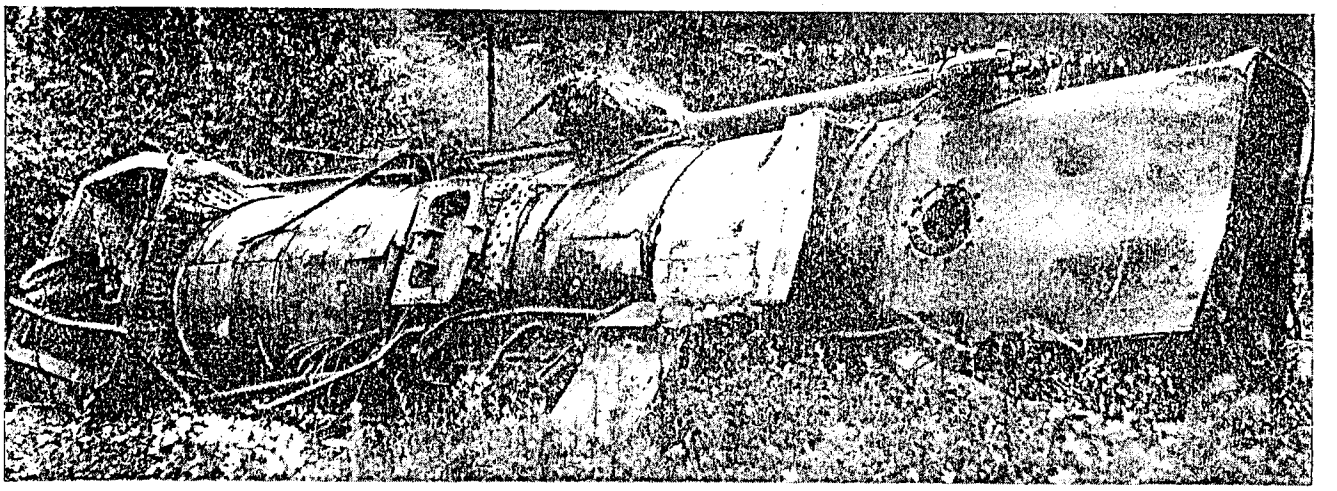
Now I am not enough of an optimist to hope that these measures are going to save the Milwaukee entirely from these regrettable catastrophies. I know better because, unfortunately, we have had some regardless of these appeals. I am realistic enough to know that as long as there are enginemen who, like the rest of us, are made of common clay and subject to human frailties we shall occasionally be confronted with these tragedies. I do know, on the other hand, however, that the assurance given enginemen that they will have a friend in court, if I may use that expression, has caused them on several occasions to kill the locomotive and, incidentally, temporarily tie up part of the railroad, before the critical moment, when the overheated crown sheet could no longer stand the pressure, arrived. Subsequent inspection revealed that had they waited only perhaps a few seconds longer the names of the crew would have been in the obituary column. One incident, not unlike many others except in its detail, might be of interest:

One morning, as I arrived at the office, I found an engineman waiting to see me. His worried look caused me to extend the somewhat discourteous, but in railroading not altogether unorthodox, greeting, particularly to an old acquaintance: "What the h . . . is riding you?" He then related that while on a time freight the previous evening, on short time ahead of a passenger train, he had decided to run a certain water tank. He did so because he felt that he had sufficient water to go to another watering station where he had a meeting point with another train and by so doing he would largely reduce the delay to his train, which for some reason was already late. As will happen in railroading, and does happen when least expected, when he was a few miles out of town an air hose broke, stalling the train. As it seldom rains but what it pours on such occasions, he stalled in a sag and, to make a long story short, in his endeavor to get the train going after the air hose was fixed, he found himself in the predicament of being so short of water that he could not even make the next water tank running light.

He related the various attempts made in the interim to get water into the boiler; they are all familiar to most of us. He tried first one injector and then the other. The fireman then looked into the water cistern and found it as dry as the *Congressional Record*. The brakeman cut the engine off and the engineer tried to make the water tank, but as he stated, each mile seemed to be twice as long as ever before. When the lower gage cock began to register dry steam, although he had the throttle open and brakes partly set, he decided it was time to follow bulletin instructions, come what may. Subsequent inspection showed that he had not killed the fire one second too soon, as several radials had started to pull and a small area of the crown sheet had been pretty well baked.



Pocket in a crown sheet, forward of the syphons, caused by overheating due to low water. Two employes were killed and one employe was injured in this accident.



The result of an explosion caused primarily by a collision in which the locomotive was derailed and came to rest leaning to the right with the front end down an embankment. This position caused parts of the firebox sheets to be bared of water which resulted in overheating. The explosion occurred about 10 minutes following the derailment—after the engineer, who had previously alighted on the ground, had returned to the locomotive in an apparent attempt to take measures to prevent the overheating of the exposed areas of the firebox. The engineer and one non-employe were killed and one employe and 21 non-employes were injured in this accident.

When he was through with his story I told him that naturally it was too bad he had tied up the railroad but under the circumstances that was a lot better than blowing up the engine with attendant serious consequences. I told him to go and get a good rest and in the meantime I would get in touch with his superintendent and let that official know we were all pretty fortunate we did not have a worse mess on our hands than the temporary tie-up had caused.

Among the very important, in fact, the most important functions of a crew when taking charge of a locomotive, no matter when or where, should be to examine the interior of the firebox for leaks, check the water in the tender and try the injectors and water pump (if the engine is so equipped), water glass and water column and the gage cocks. After satisfying themselves that everything is in order there is nothing more important than being on the alert in frequently observing the correct water level while en route on the road or during a day's work in the terminal. If the water glass is observed regularly, the water glass drain valve used frequently, careful notice made that the water glass is not sluggish, and gage cocks tried often, there will never be any boiler explosions caused by low water—providing, of course, that the locomotive crews act according to the indications and do not play with dynamite.

The most important duty of road foremen and traveling engineers to perform while riding locomotives is to be sure that crews carefully observe these important functions. In traveling over the system I frequently enjoy rides on locomotives and if it is noticed the crews do not religiously observe the water level I take them as well as the respective traveling engineers to task for not having instilled this important habit in their minds.

We know from experience that there is always a possibility of misreading the water level. There may be some strange reflection from the light illuminating the glass, causing a false level to be read; there may be a defective gasket causing a false level in the glass or there may be a pocket in a pipe; in short, there are many things that might cause a false level to appear. Therefore, it is of the utmost importance that the water glass and gage cocks be frequently tried.

Water in the boiler evaporates rapidly when the locomotive is worked to capacity and it does not take long for the water to reach an unsafe level when not replenished at the rate at which it is being consumed. There is no more important function for motive power officers and safety first supervisors than continuously urging enginemen never to fail to be on the alert in observing and maintaining a safe water level.

How the lack of alertness of a locomotive crew in this respect nearly caused a serious accident, far more serious than actually occurred, was vividly called to my attention a few years ago. I was aroused from a pleasant sleep in a Pullman one night by the porter, who handed me a message that a certain freight engine had had a crown sheet accident not far away. I immediately dressed and at the next station secured more particulars, after which I obtained the services of a section foreman and his section car and proceeded to the scene of the accident, which was some miles distant. During the night, prior to the accident, some new snow had fallen and for several miles before reaching the point where the accident had occurred there was unmistakable evidence in the snow that the injector had not picked up the water. Had the crew watched the water level carefully they would have noticed that it disappeared below a safe level. As it was, they were not aware that anything was amiss until a score of radials pulled and sent the locomotive crew and head brakeman to the hospital. Fortunately, they all recovered but their injuries might easily have been fatal as the potentialities for a more serious accident surely were there.

The time element between the disappearance of the water in the bottom of the water glass and the critical moment the accident actually occurs depends, of course, on many factors, such as construction of the boiler, temperature of the fire, capacity at which the locomotive is being worked, nature of the track and whether any or no water is going into the boiler, etc. On the supposition that no water enters the boiler, a very few minutes, surely not to exceed five or six, would permit the crown sheet to become red hot and at this temperature the tensile strength is reduced to only a few hundred pounds per square inch and the inevitable is bound to occur.

To sum up, everything that can possibly be done in the matter of design and maintenance of the boiler and boiler appurtenances to keep them in the best possible mechanical condition, should always be considered the most important duties of

those who have these matters in charge. After that is done, then crown sheet failures can be prevented only by enginemen always being on the alert in observing the water level. If for any reason a safe water level cannot be maintained there is only one thing to do and that is to kill the fire, the sooner the better.

Questions and Answers

The Air Brake

Answers by ROY J. KNAPP

2386. Air Brake Study.—"Although I have just started firing I am interested in learning all that I can about air brakes so that I will be able to pass examinations creditably. What in your opinion is the best method of doing this? I want to get started out right and avoid being confused, if possible."—D. S.

ANSWER.—We wish to congratulate you on your ambition and we are sure you will be well rewarded for your efforts.

Correspondence schools offer some very fine courses on air brakes and you can obtain literature from the manufacturers by writing their nearest office, advising the equipment you have in mind. We recommend that you do both and call on this department frequently.

2387. Triple Valves.—"Please name the different kinds of triple valves and explain the improvements made in later types."—Y. E.

ANSWER.—The developments in triple valves, starting in 1886 with the plain triple, are as follows:

1886—Plain triple for freight and passenger.

1888—*H* and *P* types quick action triples for freight and passenger.

1908—*K* type triple for freight, with quick service, retarded release, uniform recharge.

1908—*L* type quick action triple with quick service, graduated release, quick recharge, high brake cylinder pressure in emergency for passenger cars.

1912—Schedule *UC* with universal control valve. Improved passenger car brake for heavier cars and faster schedules, with the following improvements:

Certainty and uniformity of service action

Maximum service stability and release sensitiveness

Quick service feature

Improved quick recharge and graduated release features

Maximum practicable difference between service and emergency braking force

Maximum brake cylinder pressure in emergency obtained in shortest possible time

Service and emergency functions controlled by independent portions of the valve

Protection against depletion of the air system to a dangerously low point

Facility for adapting the equipment to any set of service conditions

1932—*AB* freight triple, with the following improvements: Service and emergency portions separated, improved quick service, improved release, improved emergency, strainer protection, improved release valve, improved pipe fittings, fast transmission of quick service and emergency action.

1937—D-22 control valve for passenger cars, with the following improvements:

Improved quick service

Improved graduated release

Improved emergency transmission speed

Improved release after emergency

Increased capacity

More uniform brake cylinder pressure

Simplified construction

Harmonious interchange

High speed conversion

2388. Brake Valves.—"What are the different types of automatic and independent brake valves and the positions on each?"—G. D.

ANSWER.—There are many different types of automatic and independent brake valves in use and we will name some of the most common types. The H-6 automatic brake valve is used with No. 6-ET locomotive brake equipment and the six positions, beginning at the extreme left, are as follows: release, running, holding, lap, service, and emergency.

In the following paragraphs the positions are taken up in the order in which they are most generally used.

Charging and release position: The purpose of this position is to provide a large and direct passage from the main reservoir to the brake pipe, to permit a rapid flow of air into the latter to (a) charge the train brake system, (b) quickly release, but (c) not release locomotive brakes, if they are applied.

If the handle were allowed to remain in this position the brake system would be charged to main reservoir pressure. To avoid this the handle must be moved to running or holding position. To prevent the engineman from forgetting this, a small port discharges feed valve pipe air to the atmosphere in release position with sufficient noise to attract his attention to the position in which the valve handle is standing. In this position also main reservoir air flows to the low pressure head of the compressor governor.

Running position: This is the proper position of the handle (a) when the brakes are charged and ready for use, (b) when the brakes are not being operated, and (c) to release the locomotive brakes. In this position a large direct passage is opened from the feed valve pipe to the brake pipe so that the latter will be charged as rapidly as the feed valve can supply the air, but cannot attain a pressure above that for which the feed valve is adjusted.

The equalizing reservoir charges uniformly with the brake pipe, keeping the pressure on the two sides of the equalizing piston equal. Air at main reservoir pressure, which is present at all times above the rotary valve, passes to the low pressure head of the compressor governor. The distributing valve release pipe is connected with the atmosphere.

Service position: This position gives a gradual reduction of brake pipe pressure to cause a service application. The gradual reduction is to prevent quick action. The brake pipe discharge is also gradually stopped to prevent the pressure at the head end of the brake pipe being built up by the air flowing from the rear, which might cause some of the head brakes to kick off.

This department is maintained for the purpose of answering questions of members covering locomotive running and repairs, air brake equipment and diesel motive power.

Only questions submitted for publication will be answered. Initials of members will be used in this connection except that should a brother so desire he may substitute a nom de plume.

No attention will be paid to anonymous communications. In all cases the correct name, address and lodge number must be given by the correspondent.