

INTERSTATE COMMERCE COMMISSION

NINTH ANNUAL REPORT

OF THE

CHIEF INSPECTOR
BUREAU OF LOCOMOTIVE INSPECTION

TO THE

INTERSTATE COMMERCE COMMISSION

FOR THE FISCAL YEAR
ENDED JUNE 30, 1920



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ANNUAL REPORT OF THE CHIEF INSPECTOR OF LOCOMOTIVE BOILERS.

OCTOBER 1, 1920.

To the Interstate Commerce Commission:

In compliance with section 7 of the act of February 17, 1911, as amended March 4, 1915, I have the honor to submit the Ninth Annual Report of the Chief Inspector, covering the work of the Bureau of Locomotive Inspection for the fiscal year ended June 30, 1920.

The data contained in this report covers all defects on all parts and appurtenances of the locomotive and tender, including the boiler, which were found and reported by our inspectors, together with all casualties resulting from the failure of any part or appurtenance of the locomotive or tender, including the boiler.

The succeeding tables and charts have been arranged so as to permit comparison with previous reports, as far as consistent, and show in concrete form the number of locomotives inspected, the number and percentage of those inspected found defective, and the number ordered out of service because of not meeting the requirements of the law, together with the total number of defects found. They also show the total number of accidents caused by failure from any cause of the locomotive or tender, including the boiler, and all parts and appurtenances thereof, reported by the carriers, or discovered by our inspectors, together with the number of persons killed or injured due to such failure.

Locomotives inspected, number found defective, percentage inspected found defective, number ordered out of service, and total defects found by comparison.

	1920	1919	1918	1917
Number of locomotives inspected.....	49,471	59,772	41,611	47,542
Number found defective.....	25,529	34,557	22,196	25,909
Percentage found defective.....	52	58	53	54.5
Number ordered from service.....	3,774	4,433	2,125	3,294
Total defects found.....	95,066	135,300	78,277	84,883

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Number of accidents, number killed, and number injured, reported, and investigated, covering failures of all parts and appurtenances of the entire locomotive and tender by comparison.

	1920	1919	1918	1917
Number of accidents.....	843	565	641	616
Decrease from previous year.....	149.2	111.8	14.1	
Number killed.....	66	57	46	62
Decrease from previous year.....	115.8	123.9	25.8	
Number injured.....	916	647	756	721
Decrease from previous year.....	141.6	14.4	14.8	

¹ Increase.

The following table shows the number of accidents, number of persons killed, and number injured, due to the failure of some part or appurtenance of the locomotive boiler only, which were reported by the carriers, with their percentage of decreases by comparison of the fiscal years ended June 30, 1912 and 1913, with the fiscal years ended June 30, 1919 and 1920:

	1920	1919	1913	1912
Number of accidents.....	439	341	820	856
Increase 1920 over 1919.....	28.8			
Decrease 1920 from 1912.....	48.7			
Number killed.....	48	45	36	91
Increase 1920 over 1919.....	6.7			
Decrease 1920 from 1912.....	47.2			
Number injured.....	503	413	911	1,005
Increase 1920 over 1919.....	21.8			
Decrease 1920 from 1912.....	49.9			

Number of derailments due to defects in or failure of parts of the locomotive or tender, reported to and investigated by this bureau, and number of persons killed and injured as a result, by comparison.

	1920	1919	1918	1917
Number of derailments ¹	7	7	2	4
Number killed.....	7	6	2	1
Number injured.....	18	7	2	21

¹ Only derailments, reported as being caused by defects in or failure of parts of the locomotive or tender have been investigated by this bureau.

The following table shows the total number of persons killed and injured by failure of locomotives or tenders, or some part or appurtenance thereof, during the four years ended June 30, 1917-1920, classified according to occupations.

	1920		1919		1918		1917	
	Killed.	Injured.	Killed.	Injured.	Killed.	Injured.	Killed.	Injured.
Members of the train crew:								
Engineers.....	16	272	14	194	11	245	16	230
Firemen.....	20	404	22	265	19	306	21	304
Brakemen.....	9	77	11	82	6	62	13	60
Conductors.....	2	19	2	16		21	3	14
Switchmen.....	4	19	1	7	2			8
Roundhouse and shop employees:								
Boiler makers.....	2	9	1	9		11		11
Machinists.....	1	20		5		11		8
Foremen.....		3		3	1			1
Inspectors.....		1		6	4	4		3
Watchmen.....	4	3		2		3		5
Boiler washers.....		13		7	1	4		7
Hostlers.....		13		6		8		6
Other roundhouse and shop employees.....	3	30	1	11	2	19	2	19
Other employees.....	4	26	3	23		26	5	22
Nonemployees.....	1	7	2	11		24	1	23
Total.....	66	916	57	647	48	756	62	721

All accidents which were reported to this bureau, as required by section 8 of the law, and rules 55 and 162 promulgated thereunder, were carefully investigated and a report rendered as required, and a remedy applied, as far as possible, which would tend to prevent recurrences. Copies of such reports have been furnished all interested parties when requested, for the purpose of acquainting them with the conditions disclosed by our investigations.

A summary of all accidents and casualties occurring during the fiscal year ended June 30, 1920, as compared with the year ended June 30, 1919, covering the entire locomotive and tender and all of their parts and appurtenances, shows an increase of 49 per cent in the number of accidents, an increase of 16 per cent in the number killed, and an increase of 42 per cent in the number injured. This increase is due almost wholly to disregard for the requirements of the law and rules, as well as to safety of construction and operation. This is especially true with what are sometimes considered unimportant parts; for instance, 26 per cent of the increase in accidents and injuries was due to failure of grate shakers; 10 per cent was due to failure of reversing gear; and 10 per cent to failure of squirt hose. The table shown on pages 41 and 42 shows the source of other accidents, which could have been prevented to a large extent by proper inspection and repairs, as required by rules 7 and 104, which are among the most important of the rules.

A summary of all accidents and casualties caused by failure of the boiler and its appurtenances only, for the fiscal year ended June 30, 1912 (the first year of the existence of the law), as compared with the year ended June 30, 1920, shows a decrease of 47 per cent in the number of accidents, a decrease of 48 per cent in the number killed,

and a decrease of 49 per cent in the number injured. These decreases are especially gratifying when considering the increased number of locomotives in service and the increased traffic being handled, together with the increased duties imposed on the inspectors by the amendment to the boiler-inspection law, which extended their duties to the entire locomotive and tender and the parts and appurtenances thereof, which has added greatly to their work. These decreases demonstrate the wisdom of complying with the requirements of the law and rules, and the wisdom and foresight of its advocates when requesting its enactment.

As shown by the table on page 4, derailments due to defects in or failure of parts of the locomotive or tender have been the direct cause of a number of most serious accidents and the loss of life and limb as well as damaged property and have forcibly demonstrated the necessity for proper inspection and repair of the running gear, driving gear, and brake rigging.

During the year the inspectors of this bureau were called upon by the commission to perform various duties not in connection with their regular work, which materially reduced the number of locomotives shown inspected by them, as well as the number ordered out of service, and it appears that certain railroad officials and employees have taken advantage of their temporary absence and permitted locomotives to remain in service with serious defects, which would have been known to them had proper inspections been made and reports rendered as required.

It was found necessary to ask the courts to inflict the penalty provided in section 9 of the law, because of the defective condition in which locomotives were being operated by one carrier and its willful violation of the requirements of the law and rules. This case is now pending and is set for the October term of the court. It is evident that unless an immediate improvement is made by certain other carriers it will be necessary to file similar suits in the near future. That the law places the burden of proper inspection and repair and compliance with the rules of inspection on the carriers owning or operating the locomotives seems to have been lost sight of, and this is reflected in the increased number of accidents and casualties during the year.

So that detailed consideration may be given to the source of accidents resulting from failure of the various parts and appurtenances of locomotives and tenders, the charts on pages 36 to 39 were prepared. Careful consideration of these charts will readily furnish information as to the source of accidents which are causing serious and fatal injury, and which if taken advantage of in accordance with the spirit and intent of the law will result in the elimination of a large percentage of such accidents.

In my last annual report attention was directed to some violent explosions where the failure of seams united by the autogenous process was a strong contributing factor to the seriousness of the accident. During the year a number of accidents have been investigated where the autogenous welding failed with evident increasing fatal results, in view of which, and considering that the percentage of failures of such welds involved has not decreased, I am still of the opinion that such methods should not be applied on any part of the boiler where the strain to which the structure is subjected is not carried by other construction which fully conforms to the requirements of the law and rules, nor in the so-called low-water zone of a fire box, where overheating and failure are liable to occur. This should apply with equal force to all parts of the locomotive and tender subject to severe strains and shocks, where, through failure, accidents to employees and the traveling public might occur.

A transcribed report showing defects found on all locomotives ordered out of service, and those found approaching violations of the law and rules has been furnished the chief operating officers of the carriers, so that they might be fully informed of the condition of their locomotives and we have in all other ways cooperated with the carriers to the fullest extent in bringing about safe and proper conditions.

During the year, 258 applications were filed for extension of time for the removal of flues, as provided in rule 10. Investigation showed that in 31 of these cases, the condition of the locomotives was such that no extension could properly be granted. Twenty-five were in such condition that the full extension requested could not be granted, but an extension for a shorter period within the limits of safety was allowed. Ten extensions were granted after defects disclosed by our investigation had been repaired. Thirty-seven applications were withdrawn for various reasons and the remaining 155 were granted for the full period requested.

As provided in rule 54, there were filed 1,680 specification cards and 5,584 alteration reports. These were carefully checked in order to determine whether the boilers represented were so constructed as to be in safe and proper condition for service, and that the stresses given had been correctly calculated.

The effective date of the requirements relative to the factor of safety for locomotive boilers, as fixed by the commission's order has made necessary the strengthening of various parts of numerous boilers and a reduction in the working pressure on many of the older and weaker ones.

During the year, close attention was given to the equipping of locomotives with headlights.

the commission's orders of December 26, 1916, and December 17, 1917, and reports indicate that on July 1 (the date fixed for full compliance with the requirements) practically all locomotives in service were equipped in accordance therewith. These lights are meeting with the hearty approval of employees and so far as we are able to learn, of the officials in charge, where the locomotives are in operation. The general expression is that "They add greatly to the safety, comfort, and economy of operation."

No formal appeal has been taken from the decision of any inspector, during the fiscal year, as provided in section 6 of the law, which again demonstrates the thoroughness and good judgment which characterizes their work.

It will be seen from this and previous reports that firebox failures, due to crown sheets being overheated, where no contributory cause could be found, are among the most prolific sources of fatal accidents.

With the development of the modern locomotive, new difficulties in design, construction, maintenance, and operation have been created. One of these has been to secure a correct indication of the height of water over the crown sheet, under all conditions of service.

In the locomotive boiler, which usually has a sloping back head and is generally equipped with brick arch and arch tubes, the heat severely impinges on the door sheet and back end of the crown sheet, creating severe agitation and rapid circulation through the arch tubes, and up the back head. The water glasses and gauge cocks, as generally applied, only indicate a corresponding level of water while the locomotive is at rest, with no steam escaping, but when the safety valves lift or with the throttle valve open, and the locomotive in operation, the gauge cocks, when applied directly in the boiler, indicate a higher level of water than do the water glasses, when they are properly applied and maintained. This discrepancy between these devices has heretofore been taken as a matter of natural consequence, and little consideration given to the cause or the result of the conflicting registrations—one or the other of which must be wrong.

Practically all enginemen and others having to do with the operation of the locomotive, true to tradition, believe that the correct height of water over the crown sheet is always indicated by the gauge cocks, and that the level indicated by the water glasses is unreliable and not to be depended upon; therefore, it is reasonable to believe that enginemen have frequently depended on gauge cocks as being correct, when in fact the true level was much lower, and, as a consequence, damaged crown sheets have resulted.

With this thought in mind, it was deemed advisable that a series of comprehensive tests be made for the purpose of determining the

action of water in the boiler on the water-indicating appliances, with respect to their correct registration.

Realizing that the variation which existed creates an unsafe condition, and that its cause should be determined and a remedy applied, experiments were made on a number of locomotives of different classes, on 14 railroads in various sections of the country.

Excerpts from tests made on five railroads on which the most extensive experiments were conducted will serve to briefly describe the surprising conditions disclosed. During all of these tests and observations, the representatives of this bureau were accompanied and ably assisted by representatives from the mechanical department of the various railroads.

Tests where observations were carefully recorded are briefly summarized as follows:

The locomotives on which the first series of tests was made were of the Mallet compound type, used in bad water districts, equipped with boilers of the crown-bar type, with wide fire boxes, superheaters, and used oil for fuel. The devices for indicating the water level consisted of three gauge cocks spaced 3 inches apart and applied directly in the back head near the knuckle, at right angles to the sloping sheet, and one water glass with bottom connection entering the back head approximately 3 inches below the back end of the crown sheet; the top connection entering the back head 2 inches below the knuckle. The lowest reading of the water glass and gauge cocks was $3\frac{3}{8}$ inches above the highest part of the crown sheet.

The back heads of these boilers were braced by a T iron, extending crosswise, at approximately the same level as the back end of the crown sheet.

In order to determine the action of the water as indicated by these appliances, observations were made during five trips in freight service, under varying operating conditions and on varying gradients.

With the locomotive on straight track and no indication of foaming, water would issue from the top gauge cock when it was opened, both while standing and in operation, while the safety valves were open, or the throttle valve open, regardless of the level registered by the water glass.

At the completion of the fifth trip three additional gauge cocks were applied in the back head, parallel with the horizontal center line of the boiler, the top one entering back head $10\frac{1}{2}$ inches below the top knuckle and $10\frac{1}{2}$ inches to the right of the vertical center line, with the same vertical reading as the standard application. These were applied for the purpose of determining the effect of changing their location toward the vertical center line of the back head and

away from the knuckle, where the upward circulation of the water was believed to be greater than near the center.

An experimental water glass was also applied on the left side of the boiler opposite the back flue sheet; the top connection entered the wrapper sheet on the top center line 15 inches back from the throttle dome; the bottom connection entered the wrapper sheet on the side. The lowest reading of this glass was 1 inch above the highest part of the crown sheet.

With this arrangement observations were made during five additional trips, when the same conditions were found to exist that had been noted in the previous tests, with respect to the original gauge cocks, namely, full water showed at the top gauge cock regardless of the level indicated by the water glasses, while the experimental gauge cocks indicated a level approaching that indicated by the water glasses while operating with open throttle or safety valves blowing.

While operating with throttle wide open and water glass three-fourths full, the bottom connections to both water glasses were frequently closed and drain valves opened, when dry steam would steadily flow through the experimental water glass and solid water through the original water glass, which glass also showed the water in severe agitation while the locomotive was in operation. These experiments demonstrated that the level of water indicated by the gauge cocks and water glasses varied with their point of connection with the boiler, and indicated that a higher level of water prevailed at the back head than existed farther ahead.

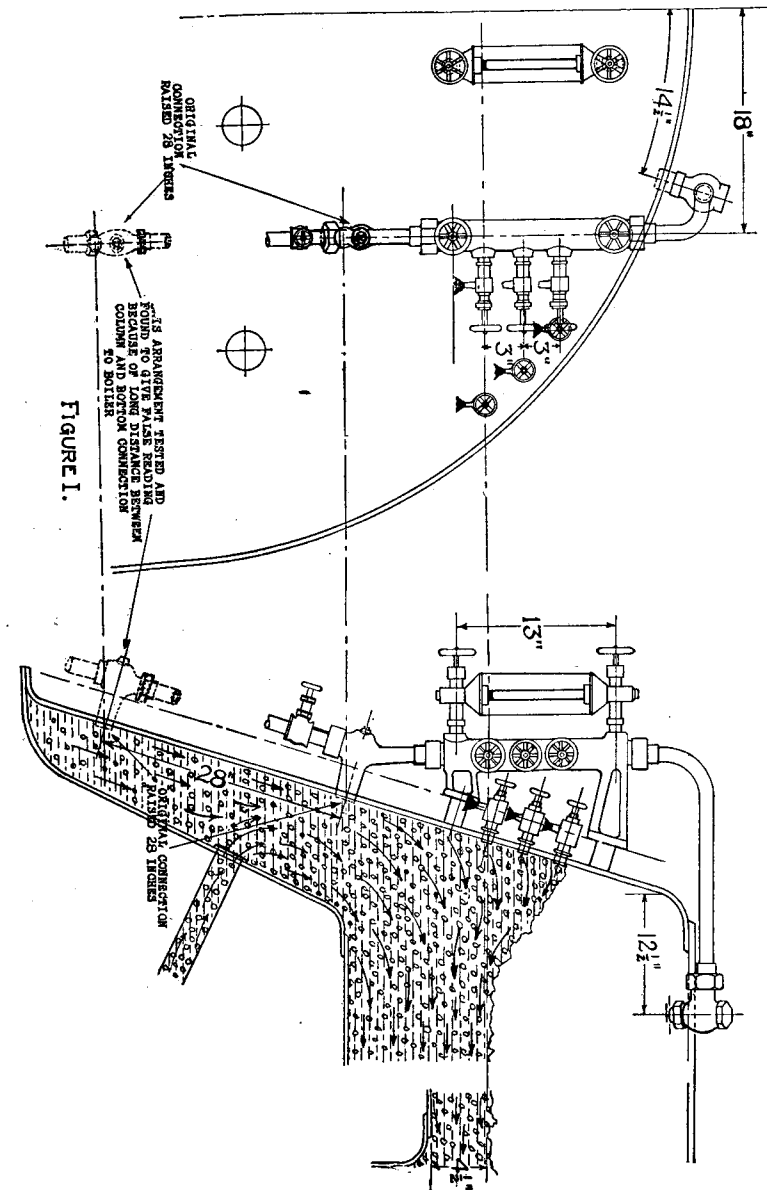
It is believed that the transverse T iron applied to the back heads of these boilers acted as a baffle plate and hindered the movement of water up the back head near the center and consequently decreased the variation between the level of water indicated by the experimental gauge cocks and that registered by the water glasses.

As a result of these experiments, which were brought about by the large number of crown sheets being damaged and fusible plugs melted, the gauge cocks and water glass were moved toward the vertical center line of the boiler, which seems to have relieved the situation.

SECOND SERIES OF TESTS.

It having been concluded that the false registration of the gauge cocks when screwed directly in the boiler back head and the agitation of the water in the water glass when top connection is made near the knuckle were due to the rapid circulation of the water upward, carrying it a considerable distance above the level farther ahead, a number of locomotives were equipped with water columns, as shown by figure 1.

These locomotives were of the Santa Fe type, equipped with superheaters, stokers, used bituminous coal for fuel, carried 180 pounds steam pressure, had fire box 132 inches long and 96 inches wide, with



brick arch supported by four arch tubes and back head sloping 15° from vertical.

The water column applied on these boilers, as illustrated by figure

vertical position on the back head, 18 inches to the right of the vertical center line. The top connection was made by means of an angle valve with extension handle, extending through the top of cab, and copper pipe of $1\frac{1}{8}$ inches inside diameter, and entered the back head $12\frac{1}{2}$ inches in front of the back-head knuckle and $14\frac{1}{2}$ inches to the right of the top center line. The bottom connection was made of copper pipe of $1\frac{1}{8}$ inches inside diameter, and entered the back head 16 inches to the right of the vertical center line and 28 inches below the back end of the crown sheet. Three gauge cocks with three-eighths inch openings were attached to the right side of the column, three inches apart. One water glass was also attached, with fittings, having one-fourth inch opening. The lowest reading of both water glass and gauge cocks was $4\frac{1}{2}$ inches above the highest part of the crown sheet.

By this arrangement it was believed that when entering the boiler far enough ahead of the back knuckle to obtain dry steam at all times and by taking water from well below the crown sheet and below the agitated portion of water which was believed to exist near the back end of the crown sheet and back head, a more correct reading could be obtained than when the gauge cocks were screwed directly in the boiler head. During an approximate six months' period that these locomotives were operated with this arrangement, however, very considerable trouble was encountered, due to the extremely erratic and unreliable action of the water indications.

When the matter was brought to the attention of this bureau it was determined that something should be done to learn just what caused the trouble; therefore, numerous observations were taken under actual operating conditions, with the following general conditions noted:

At first start there was $3\frac{1}{2}$ inches of water in the glass.

Reverse lever in full forward motion, with engine working up to the slipping point and working considerable water through the cylinders for about 2 miles.

When locomotive was started the water in the glass receded very rapidly until it disappeared.

Left injector was started at once.

By opening any of the gauge cocks which had openings three-eighths inch in diameter after the water had disappeared, dry steam was emitted for a few seconds, when the water in glass and column would rise to the cock that was opened and would be maintained unsteadily at the same level until the gauge cock was closed, when the water in the glass would instantly recede slightly below this cock, which would be 2 to 5 inches higher than the level indicated before the gauge cock was opened. From this point the water would gradually recede, taking 4 or 5 minutes to drop to the low point, and, when reached, the water would work normally in the glass, but would gradually recede to different levels and sometimes out of sight, depending upon the temperature of the water in the lower connection to the column.

This test was made many times during the trip, and in all cases practically

When the drain cock to the water glass was opened, the water in the glass and column would be raised as a result and when closed, the same receding conditions prevailed as when the experiments were made with the gauge cocks, but would again settle to an indefinite point, sometimes out of sight, depending upon the temperature of the lower column connection.

The gauge cock was frequently opened slightly, so as to create a slight circulation through the column, which kept the temperature in the column and connection approximately that in the boiler, during which time the column glass and gauge cocks appeared to register correctly.

CONDITIONS OF TESTS.

During these tests the temperature of the atmosphere was below zero, which caused the water in the column and in the long pipe through which the bottom connection was made to cool rapidly, which in turn caused the level of water in the column to lower. In order to demonstrate that this reduction in temperature was the cause of the receding action in the column, ice water was poured on the bottom of the column and connection, which caused the water in the column to lower very quickly while being cooled, and would rise as soon as circulation was again established, which demonstrated that the lowering of water in the column was due to the volume of comparatively cool dead water contained in the long pipe through which the bottom connection to the column was made and which was evidently due to the density and weight of the water at different temperatures.

After noting these results, and for the purpose of comparison, another water glass and set of three gauge cocks were applied in the usual manner, as illustrated by figure 1; the water-glass connection entered the back head at the left of column, the gauge cocks entering near the knuckle. The comparative readings of all gauge cocks and water glasses corresponded. For reference purposes the gauge cocks and water glass applied to the column will be referred to as No. 1, while those applied in the usual way will be referred to as No. 2.

With the indicating devices arranged as outlined, the following general results were noted:

Previous to starting, all devices indicated a corresponding level, but when the throttle was opened or safety valves lifted, the water in No. 1 glass would recede approximately 2 inches, while that in No. 2 glass would rise. No. 2 glass indicated a level of water from 1 to 3 inches higher than that indicated by No. 1 glass. In some cases, however, the water was out of sight at the bottom of No. 1 glass, while No. 2 glass indicated a level of from 3 to 5 inches.

EFFECT OF RAISING BOTTOM CONNECTION.

After noting these results, the following change was made:

The bottom connection to the water column was raised 28 inches and moved to the right $2\frac{1}{2}$ inches. This new connection was made midway between the two old connections, and the water glass was

inches above them, about in line with the back end of the crown sheet, the object being to move the bottom connection up as close to the lower end of the column as possible, so as to reduce the volume of dead water in this connection in order to eliminate the lowering effect referred to and to avoid being immediately above the arch tubes. After this change had been made, the following general results were obtained: When starting, the level in both water glasses rose slightly and both glasses worked normally, and when throttle was closed, the level would recede slightly, the readings of both glasses corresponding under all conditions of service.

A comparison of the No. 1 gauge cocks with the No. 2 water glass showed they registered the same level when the gauge cocks were opened moderately, or a sufficient amount to obtain a correct reading, but by opening the No. 1 gauge cocks an excessive amount, or wide open, the water in the column and attached glass would rise from the bottom to the level of the cock opened. When the gauge cock was closed, the water would instantly recede to its original working level and correspond with that shown in No. 2 glass. The receding action, as noted in the previous tests and before the bottom connection was raised, was entirely absent and the water registered a corresponding level in both No. 1 and No. 2 glass under all conditions of service.

Tests of the No. 2 gauge cocks, located as they were near the knuckle of the back head, proved that they were wholly unreliable for the purpose of registering the correct level of the water in the boiler while the locomotive was working, as they showed full water at all times throughout the entire test regardless of the level indicated by the water glasses and No. 1 gauge cocks while steam was being rapidly discharged from the boiler, due without question to the rise of water up the back head. While standing and with no steam escaping the readings of both water glasses and all gauge cocks registered alike.

Further observations and tests were made while on heavy grades, but no unusual or improper conditions could be noted except that No. 2 gauge cocks registered full at all times, as previously stated, and the water in the column glass could be raised to the height of the gauge cock opened when opened excessively.

SIZE OF OPENINGS AFFECTS READINGS.

The opening in the bottom connection to the water column was then reduced to three-fourths inch and observations continued. It was thought that by restricting the inlet at the bottom of the column it would prevent the water from rising in the column and attached glass when the gauge cocks were opened excessively. The opening in the gauge cocks was also reduced from three-eighths inch to one-

fourth inch inside diameter, so as to disturb the equilibrium of the water in the column as little as possible.

On this trip particular attention was given to the action of the water as registered by the water glasses and No. 1 gauge cocks by comparison, and it was particularly noted that the level of the water corresponded at all times under the varying conditions of service, while the standard-gauge cocks registered full water at all times with a high evaporation taking place.

As previously stated, in the original arrangement the top connection to the column was fitted with an inaccessible valve, the handle of which extended through the roof of the cab, thus making it difficult to tell whether or not the valve was open and the column in communication with the boiler at the top. In order to eliminate the possibility of these valves being left closed through carelessness, as is often done with water glass cocks, they were removed. The necessity for removing these valves was demonstrated by the serious damage to a crown sheet by overheating while water showed in the water glass and the column gauge cocks, due to one of these valves having been left closed while the locomotive was being prepared for service.

THIRD SERIES OF TESTS.

The locomotives on which these tests were made were Railroad Administration heavy Mallet 2-8-8-2B type. The crown sheet was 15 feet 7 inches in length, with fire box equipped with Gaines furnace, and brick arch extending to within 68 inches of the door sheet and within 22½ inches of the crown sheet, supported by five 3½-inch arch tubes, using bituminous coal for fuel and fired with Duplex stoker. The boiler was equipped with one water column, to which three gauge cocks and one water glass were attached. Two gauge cocks were applied directly in the back head and two water glasses applied in the usual manner, one on each side of the vertical center line of the back head, as illustrated by figures 2 and 3.

The lowest reading of the gauge cocks attached to the water column, and all water glasses, was 8 inches above the highest point of the crown sheet and 13½ inches below the top of boiler back head. The limited dry steam space at the back end of this boiler had a marked effect on the readings of these devices when connected in the back head.

COMPARING GAUGE COCKS AND WATER GLASSES.

Numerous observations were made on a number of locomotives of the same type, for the purpose of comparing the action of the water in the gauge cocks and water glasses as originally applied and after certain changes were made. For the sake of brevity, however, the tests made on only one of these locomotives will be

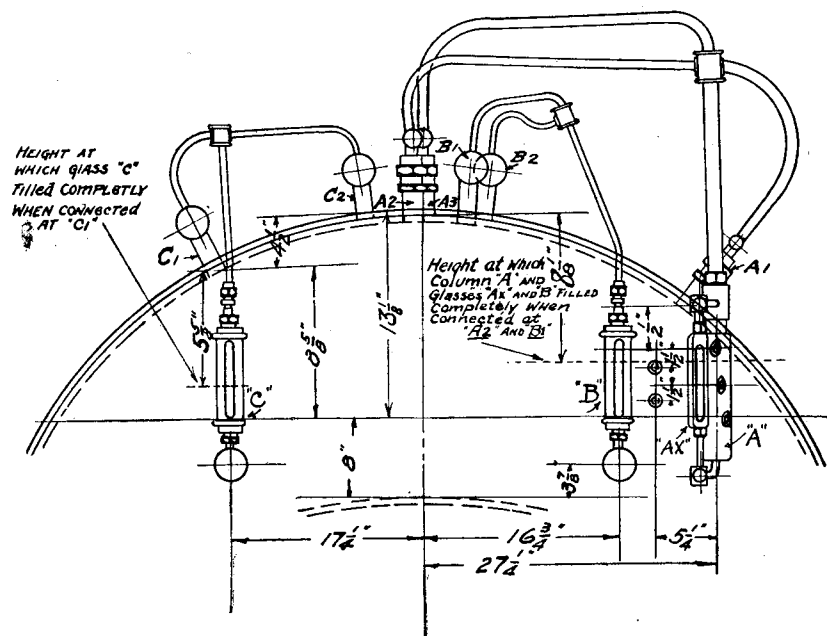


FIGURE II.

described, inasmuch as the results obtained were the same in all cases.

For the purpose of comparison, each of the connections was fitted with a valve, and extension handle, so they could be easily opened and closed, allowing changes from one to the other at will. The top connection to the right water glass was changed from its original location which corresponded to that shown for the left one, to the location shown at B1 on the highest part of back head knuckle.

It will be understood that when water, from any cause, reaches the top connection, it destroys the proper registration of such devices, and the idea in mind, when arranging the top connections in the manner illustrated, was to determine whether or not the reading of the water glasses and water column would be altered when changing from one connection to the other, which were in line with the upward flow of water between the door sheet and the back head the object being to obtain dry steam to balance the volume of water in the water glasses and water column. The result of changing from one connection to the other was indeed surprising.

While the locomotive was standing, with no steam escaping, the registration of all devices showed a corresponding level of water. A total of 121 readings was taken and recorded while on straight track and while the locomotive was working with heavy throttle with about the same fire-box temperature and steam pressure.

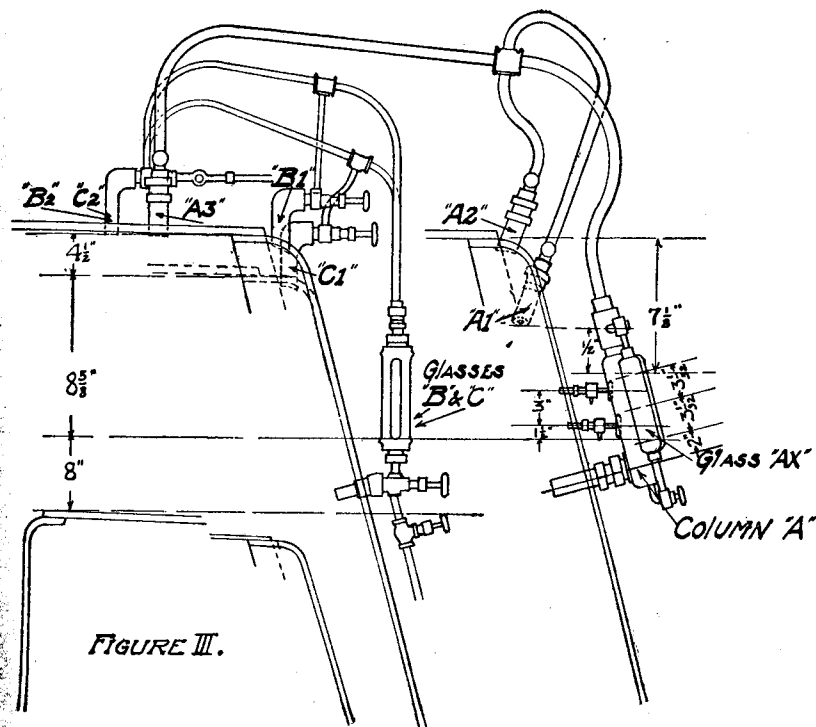


FIGURE III.

For reference purposes, the water glasses and water column with their connections, are referred to by letters and figures as follows:

- A. Water column to which three standard gauge cocks were applied.
- Ax. Water glass applied to water column.
- A1. Water column connection where it entered boiler on back head knuckle one-half inch higher than top gauge cock and 6 5/8 inches below highest part of back head as originally applied.
- A2. Water column connection where it entered boiler at highest point of back head knuckle.
- A3. Water column connection where it entered boiler on top center line in front of back head.
- B. Right water glass.
- B1. Right water glass connection where it entered boiler in front of back head.
- C. Left water glass.
- C1. Left water glass connection where it entered back head knuckle 4 1/2 inches below highest point of back head, measured vertically, and 2 1/2 inches above top water glass reading, as originally applied.
- C2. Left water glass connection where it entered boiler in front of back head.

COMPARATIVE READINGS COLUMN A AND GLASSES AX AND B.

With the locomotive working heavy throttle, column A and glass Ax, connected at A1, the original connection, would be completely filled, while glass B, connected at B1, indicated 1 inch of water.

By changing the connection A1 to A2, the water would instantly recede to a level in A and Ax corresponding with that indicated by glass B, or 1 inch, when A, Ax, and B would continue to correspond while connected at A2 and B1, until the reading approached $4\frac{1}{2}$ to 5 inches, at which point the water would become erratic and soon fill column A and glass Ax and B if the injector was slightly oversupplying the boiler, or would recede and correspond if the water was slightly lowering in the boiler. This indicated that the water was moving up the back head with fountain effect to a point reaching the connections A2 and B1, where they entered the top knuckle of the back head, $8\frac{1}{2}$ inches higher than they registered when connected at A3 and B2 on the wrapper sheet, and was illustrated by changing the connection to column A and glass B from A2 to A3, B1 to B2, when the water would instantly recede to its former reading, and the readings would then continue to correspond as long as the connections remained at A3 and B2, without regard to condition of service or height of water indicated.

These readings could be varied as often as desired by shifting connections to the boiler by use of the valves; that is, when the column connection was changed from A3 to A2 the water would immediately go from 5 inches to out of sight in glass Ax and top gauge cock would show full water; or, when changed from A2 to A3, the water would recede from out of sight to a level of 5 inches and correspond to the reading shown by glass B connected at B2.

With glass B connected at B1 the reading would correspond with column A and glass Ax when connected at A3 until the level approached 5 inches, when the water in glass B would become erratic and soon fill the glass, while column A and glass Ax, connected at A3, retained their level of 5 inches.

These experiments illustrated that column A and glass Ax were incorrect when connected at A1, the original connection, with 1 inch or more of water; and, when connected at A2, were incorrect when the level indicated exceeded $4\frac{1}{2}$ to 5 inches; and correct at all times when connected at A3; and that glass B was correct when connected at B1 until the reading indicated $4\frac{1}{2}$ to 5 inches and incorrect when more water was shown until connection was changed to B2.

With glass B registering 5 inches of water, the connection was changed from B2 to B1, when the glass would immediately fill; and with the bottom water-glass cock closed and drain valve open solid water flowed steadily through the drain pipe, which showed conclusively that the flow of water up the back head with fountain effect reached the connection B1, where it entered the back head knuckle $8\frac{1}{2}$ inches higher than the correct level of water in the boiler or that registered by glass B when connected at B2 and by A and Ax when connected at A3.

COMPARING GLASS C WITH GLASSES AX AND B AND COLUMN A.

With glass C in communication with the boiler at C1, its original connection, it registered a level corresponding to that indicated by column A, glass Ax when connected at A3 and with glass B when connected at B2, until the water registered $2\frac{1}{2}$ to 3 inches, at which time the water in glass C would become erratic, rising and lowering and quickly fill completely, providing the injector was more than supplying the boiler, notwithstanding column A and glasses Ax and B, connected at A3 and B2, worked normally and indicated $2\frac{1}{2}$ to 3 inches of water.

When glass C communication was changed from C1 to C2 the water would instantly recede from out of sight at top to a level of $2\frac{1}{2}$ to 3 inches and give a corresponding reading with column A and glasses Ax and B, which was true at all times when all connections were made ahead of back knuckle, regardless of the condition of service or the level of water in the boiler.

The reading of glass C, when it indicated 3 inches or more of water, could be changed as frequently as it was desired by changing the communications from C1 to C2 or vice versa.

It was noted on one occasion, with column A connecting at A1, glass B connected at B2, and glass C connected at C1, the locomotive moved to a left-hand curve, at which time water glass B registered 2 inches of water while column A and glasses Ax and C were completely filled.

Sixteen readings were taken on the fourth trip, with column A connected at A1, the original connection, glass B at B2, and glass C at C1, original connection, during which time glass B indicated a level of from $1\frac{1}{4}$ to $4\frac{3}{4}$ inches, while glasses Ax and C and all gauge cocks in both column and back head showed full of water. In fact the gauge cocks applied directly in the back head showed full of water at all times during these tests, while the locomotive was being operated or when the safety valves were open.

TRAP IN TOP CONNECTION AFFECTS READINGS.

By referring to figure 3 it will be noted that connections to water glasses were made to the boiler through ell connections. In changing the Street ells from their original location on the back head to the location shown at B2 and C2, the C2 connection was tapped so as to drain thoroughly, while B2 was leaned sufficiently to cause a trap to be formed. This trap caused the water in B glass to rise 2 to 3 inches higher than that registered by the left glass, and when this trap was removed the water indication in all three glasses corresponded. This condition has been found in a number of the locomotives under in-

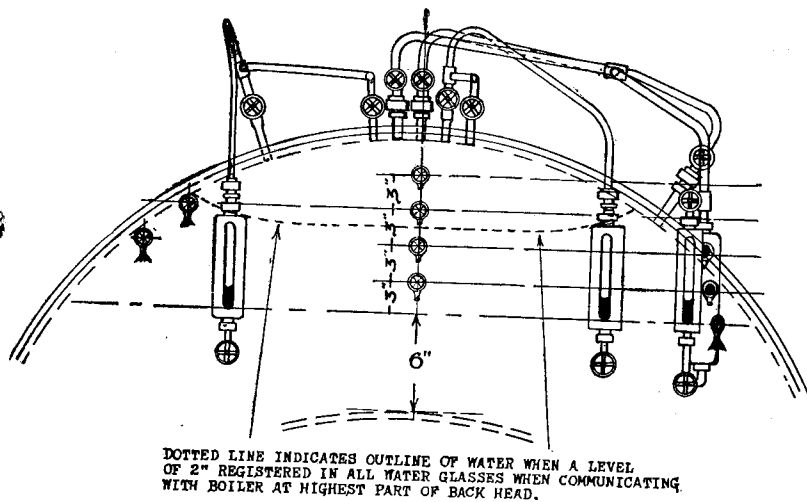


FIGURE IV.

vestigation, when, as soon as the traps were removed, the discrepancies were obviated.

FOURTH SERIES OF TESTS.

For the purpose of determining if possible the general outline of the flow of water which evidently existed at the back head, when high evaporation was taking place, tests were made on one of the Railroad Administration 2-10-2 type locomotives, equipped with five arch tubes and brick arch extending to within 51 inches of the door sheet, fired with Duplex stoker, and using bituminous coal for fuel. The test apparatus used in these tests is shown by figures 4 and 5; the sliding tubes illustrated were graduated so that correct readings could be taken.

INDICATIONS OF SLIDING GAUGE COCKS.

During two round trips many readings were taken while the locomotive was in operation. It will be noted, by referring to figures 4 and 5, that with 2 inches of water showing in all glasses and one gauge of water in the column, the gauge cocks applied on the left side of the boiler head in the usual manner indicated full water while No. 1 tube indicated strong flutter at a 12-inch adjustment, No. 2 tube indicated a strong flutter at a 9½-inch adjustment, and No. 3 tube showed an occasional flutter at the back head, showing a rise of water at the back head of approximately 7 inches above that being

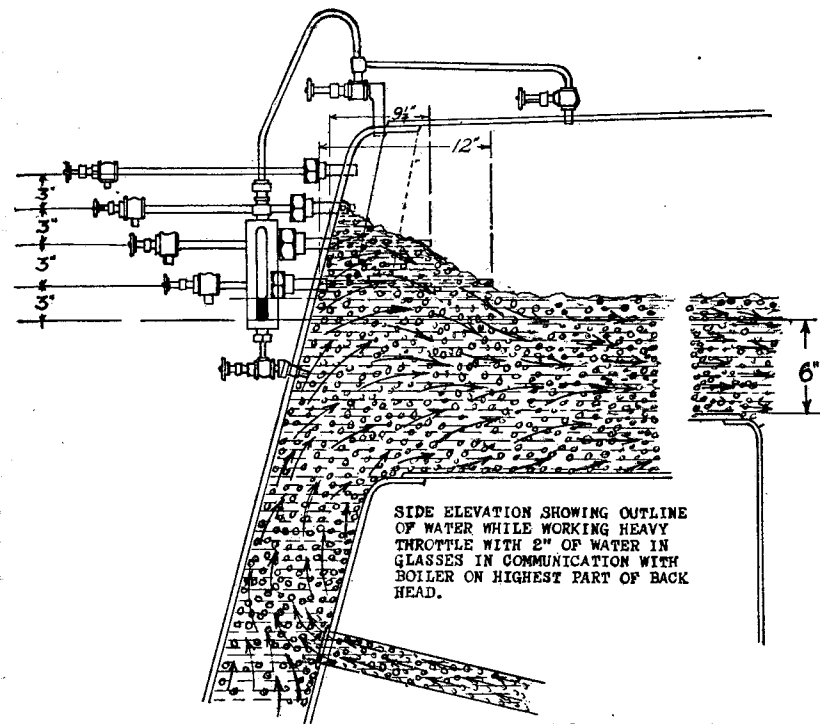


FIGURE V.

registered by the water glasses or existing farther ahead over the crown sheet.

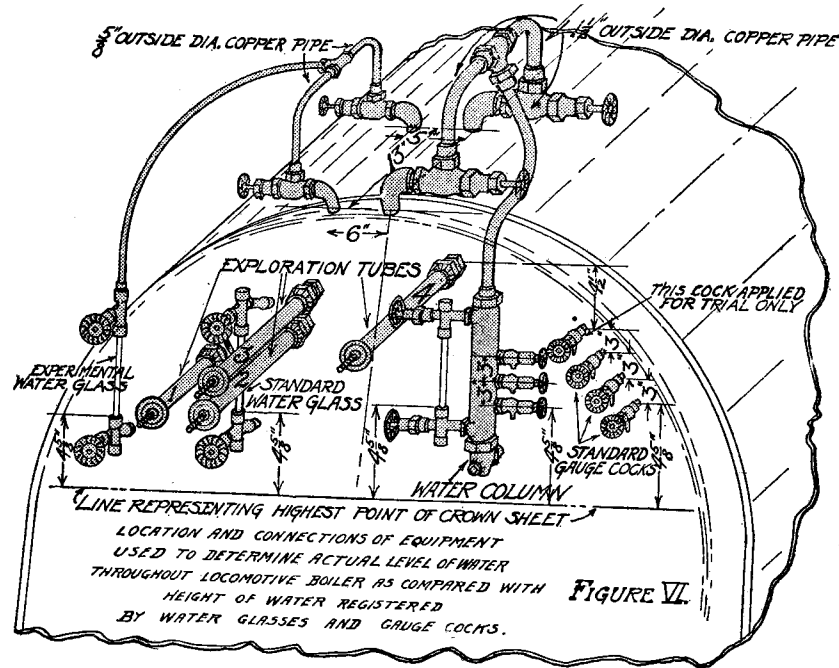
The dotted line in figure 4 indicates what we believe to be the general outline assumed by the water where it reaches a greater height on each side than at the vertical center line of the boiler. It was found during these tests that with the top connection to the water column connected at its original position the column would entirely fill when 4 to 5 inches of water was reached in the column glass. When changing from this connection to the highest point on the back head, the water would immediately recede to 4 inches, but when changing from one connection to the other on the highest part of the boiler, the readings were not affected, which indicated that dry steam was being obtained both at the back knuckle and further ahead, due, no doubt, to the increased dry steam space in the back end of this boiler and the exceedingly good water used for locomotive purposes in this district.

FIFTH SERIES OF TESTS.

To further determine the approximate outline and proportions of the water conditions existing at the back boiler head while the locomotive is being operated with heavy throttle, or when steam is being

rapidly generated and simultaneously escaping from the boiler, tests were made with appliances shown by figures 6 and 7, covering a distance of 808 miles in bad water districts on approximately level track and while handling regular tonnage.

The locomotive on which these tests were made was of the heavy 2-8-2 type equipped with superheater and Duplex stoker, using bituminous coal for fuel. The boiler had a sloping back head with fire box equipped with brick arch extending to within 52 inches of the door sheet and 30 inches of the crown sheet, supported by four 3-inch arch tubes.



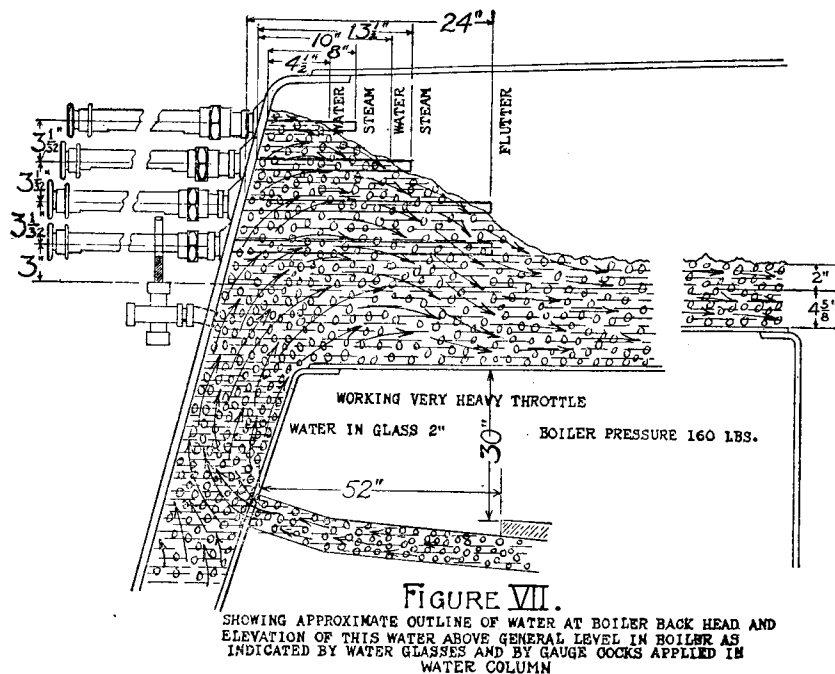
The apparatus shown by figure 6 consisted of four gauge cocks applied directly in the back head near the knuckle, one water column to which three gauge cocks and one water glass were attached, one water glass with a 9-inch reading, standard application, with both top and bottom cocks entering boiler back head direct, one water glass applied for experimental purposes with the bottom cock entering the boiler head direct and with one top connection entering the boiler head on back knuckle and one entering 13 inches ahead, and four exploration tubes or sliding gauge cocks.

Figure 7 shows a side elevation of these exploration tubes or sliding gauge cocks entering the back head parallel to the horizontal axis of the boiler with a vertical pitch of 3½ inches, giving a total vertical reading of 10½ inches, with a horizontal adjustment of 24

inches. Gradations were marked on these tubes so that accurate readings could be taken and recorded. The lower tube entered the boiler head on a level with No. 2 gauge cock. The lowest reading of all water glasses and gauge cocks was 4½ inches above the highest point of the crown sheet.

INDICATIONS OF SLIDING GAUGE COCKS.

It will be noted from this figure that while tube No. 1 was submerged, tube No. 2 showed a flutter of steam and water at an adjustment of 24 inches; tube No. 3 showed water at an adjustment



of 10 inches and steam at 13½ inches; tube No. 4 showed water at an adjustment of 4½ inches and steam at 8 inches. These readings were taken while the experimental water glass and water glass attached to the water column registered 2 inches of water, and the gauge cocks attached to the water column showed one gauge, while the four gauge cocks applied in the back head registered full.

The water in the territory where these tests were made is very light and foams badly when compound is not used. About 110 readings were taken with these tubes or sliding gauge cocks and other appurtenances used to register the water level. It is impossible to outline this flow of water accurately, as it changes with the operating conditions and the condition of the water in the boiler, but it is believed that this serves to illustrate the general condition which

prevails to a greater or less extent in all locomotive boilers, especially those equipped with brick arch and arch tubes, while the locomotive is working heavy throttle or steam is rapidly escaping from the boiler.

It was found that approximately the same conditions were disclosed as those developed in other tests, except that the outline of water reached a higher elevation and greater proportions at the backhead than those illustrated by figure 5, which is no doubt due to the extremely good water used for locomotive purposes in the district where the previous tests were made.

The readings of the water column and experimental water glass, shown by figure 6, could not be varied when changing from one connection to the other, as was the case in other tests, which we believe was due to the increased steam space in the back end of this boiler; and while the roll of water up the back head reached at times an approximate height of 12 to 13 inches above the general water level in the boiler, it did not apparently reach the top connection to these appliances in the back head knuckle.

When foaming very badly, there was slight agitation in the experimental glass when connected in the back knuckle, and occasional bubbles in the glass, but not sufficient to attract serious attention. This agitation was entirely absent when the top connection was made ahead of the back knuckle. With 1 inch of water or less, the water in the standard glass registered practically the same height as the other two glasses; with 2 to 2½ inches of water in the glass, when water was foaming, the water in the standard glass rose 2 to 3 inches higher, and there was much agitation and many bubbles in it, while the column glass and the experimental glass connected ahead showed no agitation whatever. With 3 inches or more of water in the standard glass and the water foaming badly, the standard glass would fill, and it was impossible to tell the actual height of water in the boiler by that device without closing the throttle, while the experimental glass and the glass attached to the column continued to register 3 or more inches of water, and the top gauge cock, attached to the column, would indicate dry steam when opened in the usual way, and the four gauge cocks applied directly in the boiler would register full water.

SIXTH SERIES OF TESTS.

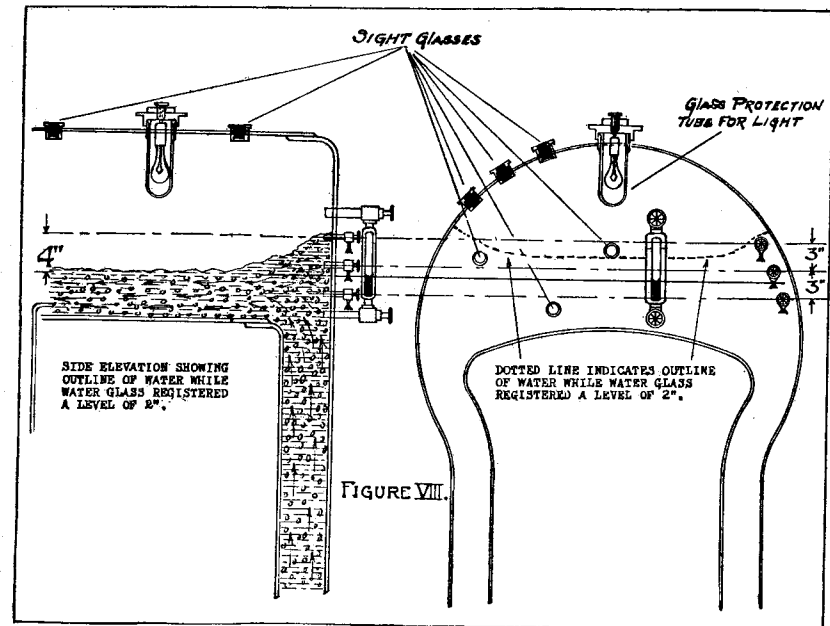
OBSERVATIONS MADE WITH LIGHT IN BOILER.

Tests were made on a comparatively small locomotive used in switching service, equipped with a wagon top, radial stayed boiler, having narrow O. G. fire box and vertical back head, the diameter of the largest course being 59 inches. A special feature which should be

borne in mind is that no arch or arch tubes were used in this boiler and that the back head was vertical.

The water-indicating devices consisted of three gauge cocks spaced 3 inches apart and applied directly in the right knuckle of the back boiler head, with a vertical reading of 6 inches, and one reflex water glass with a clear reading of 7 inches and with top and bottom connections entering the boiler head direct on the vertical part 5 inches to the right of the center line. The lowest reading of the gauge cocks and water glass was 3 inches above the highest part of the crown sheet.

So that the action of the water could be observed, a glass tube was



inserted in the top of the wrapper sheet which permitted the use of an electric light inside the boiler, which clearly illuminated the steam space over the crown sheet. Five bull's-eye sight glasses were applied over the back end of crown sheet, two over the front of crown sheet, and three in the vertical back head, so that the action of the water in this part of the boiler could be seen while under steam pressure. The arrangement of these appliances is illustrated by figure 8.

Both main rods were disconnected, cross heads blocked at end of stroke, and valve stems disconnected and so placed that steam was discharged through the exhaust nozzle and stack creating a forced draft on the fire, representing as nearly operating conditions as possible.

OBSERVATIONS.

When the throttle was closed and no steam escaping from the boiler, the surface of the water was approximately level, with a distinct circulation noted from back to front and from the sides toward the center of the crown sheet. When the safety valves lifted, the water rose with fountain effect, around the edges of the fire box, $\frac{3}{4}$ from 1 to 2 inches, and the circulation was materially increased.

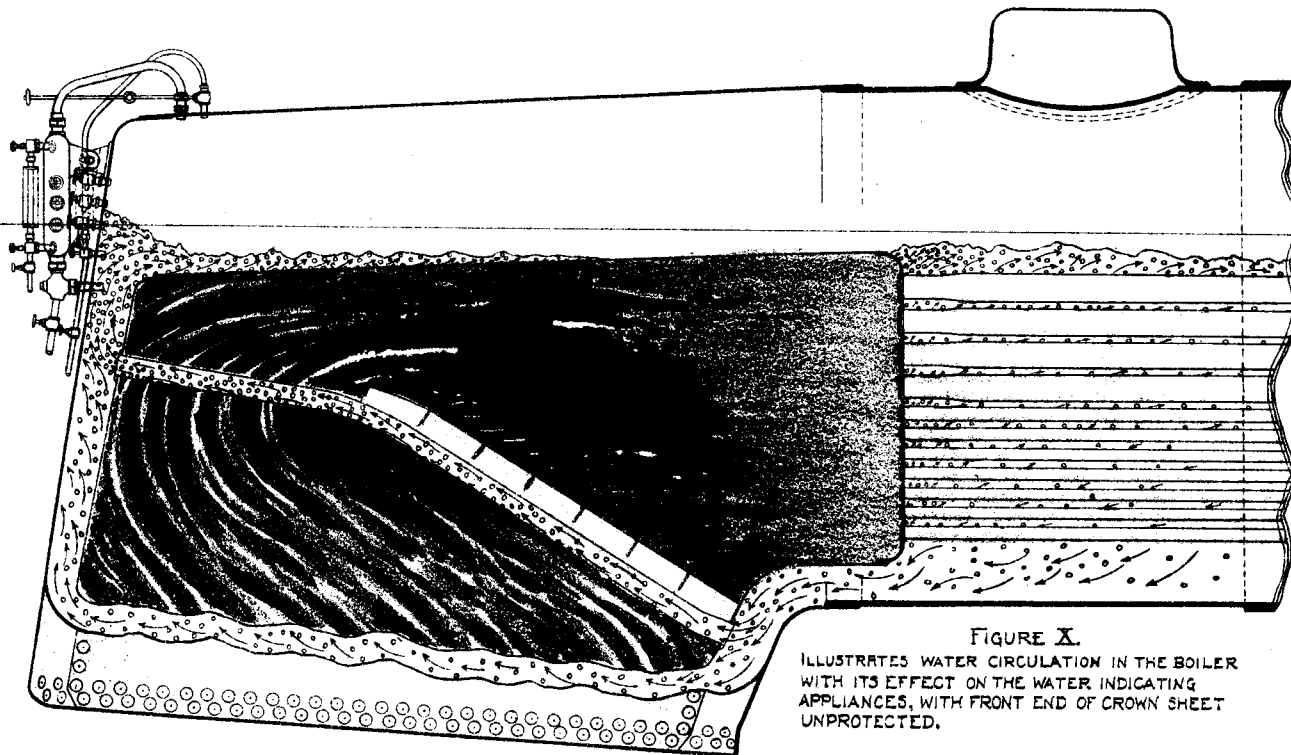
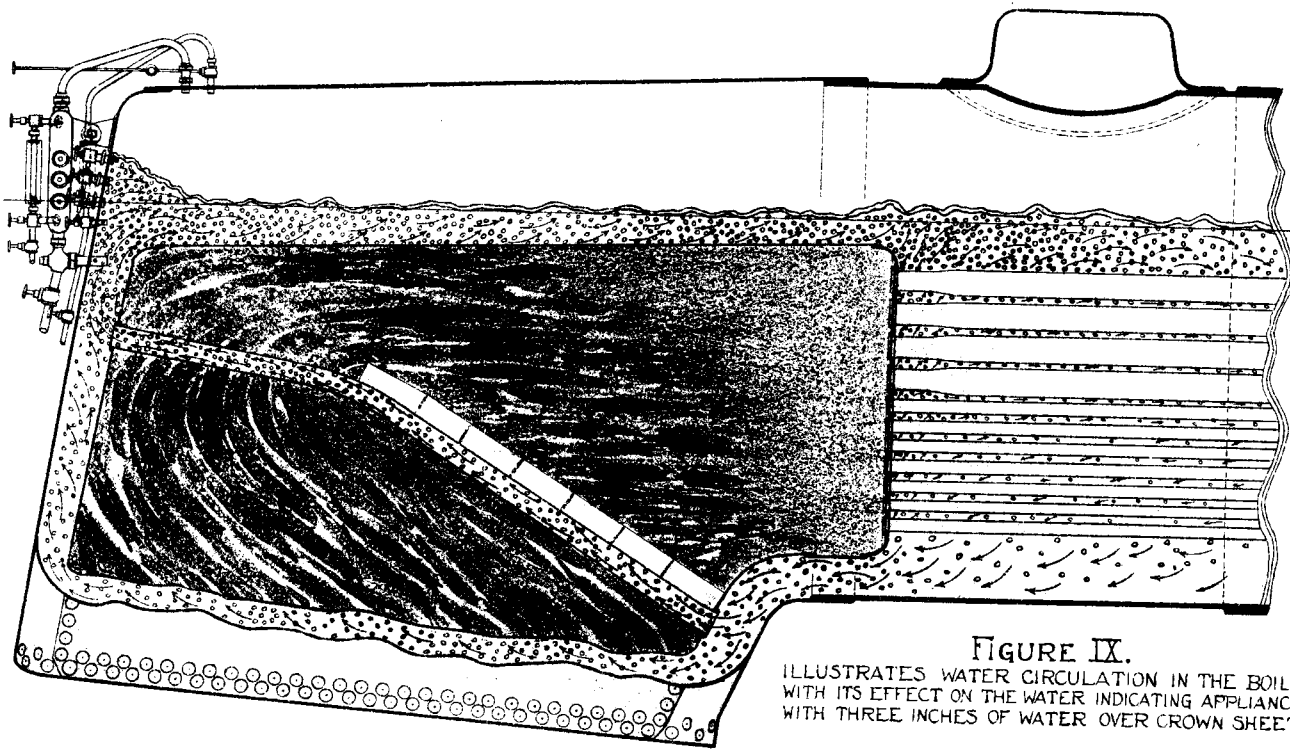
When the throttle was opened and steam was being generated and escaping from the boiler in greater volume, the level of water throughout the boiler was seen to rise 1 to $1\frac{1}{2}$ inches, which rise was registered by the water glass, and a marked flow of water, with fountain effect, was observed rising around the fire box at the back head and wrapper sheets, reaching a height above that over the remaining portion of the crown sheet of approximately 2 to 4 inches, in proportion to the amount of steam being generated and simultaneously escaping from the boiler.

The important feature to be noted is that this height of water, as seen at the back head, was approximately 4 inches at its maximum, and was registered by the gauge cocks, while at the same time it could be seen that the water glass was registering the level farther ahead over the crown sheet.

Among the interesting features observed were the size of the steam bubbles, which were approximately one-fourth to three-eighths inch in diameter, and the rapidity with which they rose to the surface and exploded. The size and number of these steam bubbles, rapidly rising, explain one of the physical reasons for the increased height of water around the crown sheet and the rapid circulation attained.

These observations establish beyond question that when steam is being generated and escaping there is an upward movement of water at the back head of the locomotive boiler which carries it above that farther ahead over the crown sheet, and that the gauge cocks, when applied directly in the boiler, register this rise of water and do not indicate the level farther ahead, while the water glass registers the level of water farther ahead and not the fountain of water at the back head.

Since the difference of 4 inches was observed between the height of water at the back head and that farther ahead in this boiler, which had a vertical back head and O. G. type fire box and was not equipped with brick arch or arch tubes, there can be little question but that in the modern locomotive boiler, which has a sloping back head and is equipped with brick arch and arch tubes, which greatly accelerates the movement of water in this part of the boiler, due to the rapid circulation through the arch tubes and the deflection of heat against the door sheet and back end of crown sheet by the brick arch, the



difference between the height of the water at the back head and farther ahead over the crown sheet must be materially increased.

Figures 9 and 10 illustrate the circulation of water in the boiler. The feed water which enters near the front and is much lower in temperature than that in the boiler, which, due to its density and weight naturally lowers and moves toward the fire box sheets where the greatest evaporation takes place. As the water is heated it rises, due to its decreased weight, influenced by the steam bubbles rising to the surface where they explode. This circulation causes a movement of water from front to back in the lower portion of the boiler, and upward around the fire box, and from back to front in the upper portion which unquestionably takes place with sufficient rapidity to carry the water around the fire-box sheets above its natural level, due to the narrow space in the water legs, where the greatest amount of heat is applied.

EFFECT OF CIRCULATION ON THE WATER-INDICATING APPLIANCES.

Figure 9 illustrates a portion of a locomotive boiler equipped with brick arch and arch tubes where the general level of water in the boiler is 3 inches above the highest part of the crown sheet, the minimum required by law, and where the water glass, when properly applied in the usual manner, and the water glass and gauge cocks attached to a properly designed and applied water column, indicate the level of water over the crown sheet, while the gauge cocks in the back head register the water at the back head. This condition has been clearly established by the tests herein described.

Figure 10 illustrates the same portion of a locomotive boiler and a condition which may exist where the water glass registration is ignored and the gauge cocks applied in the boiler are depended upon as registering the correct level. Since practically all enginemen have been taught to rely on the gauge cocks in preference to the water glass, this is an especially unsafe condition, and is, no doubt, the cause of many damaged crown sheets.

It is recognized that the volume of water in the boiler increases in proportion to the amount of steam being generated and in the same ratio that the steam bubbles below the surface are formed and expanded, the volume of which depends to a very considerable extent upon the purity of the water in the boiler and its ability to readily release the steam being generated; consequently increasing the height of water in the same proportion, which height is registered by the water glass.

RECOMMENDATIONS.

Since it has been established that gauge cocks screwed directly in the boiler do not correctly indicate the general water level the question arises as to what would be a proper appliance. After careful

investigation and tests, it is believed that figure 11 illustrates a water column that will afford the safest and most practicable method yet disclosed for accurately indicating the general water level in the boiler under all conditions of service.

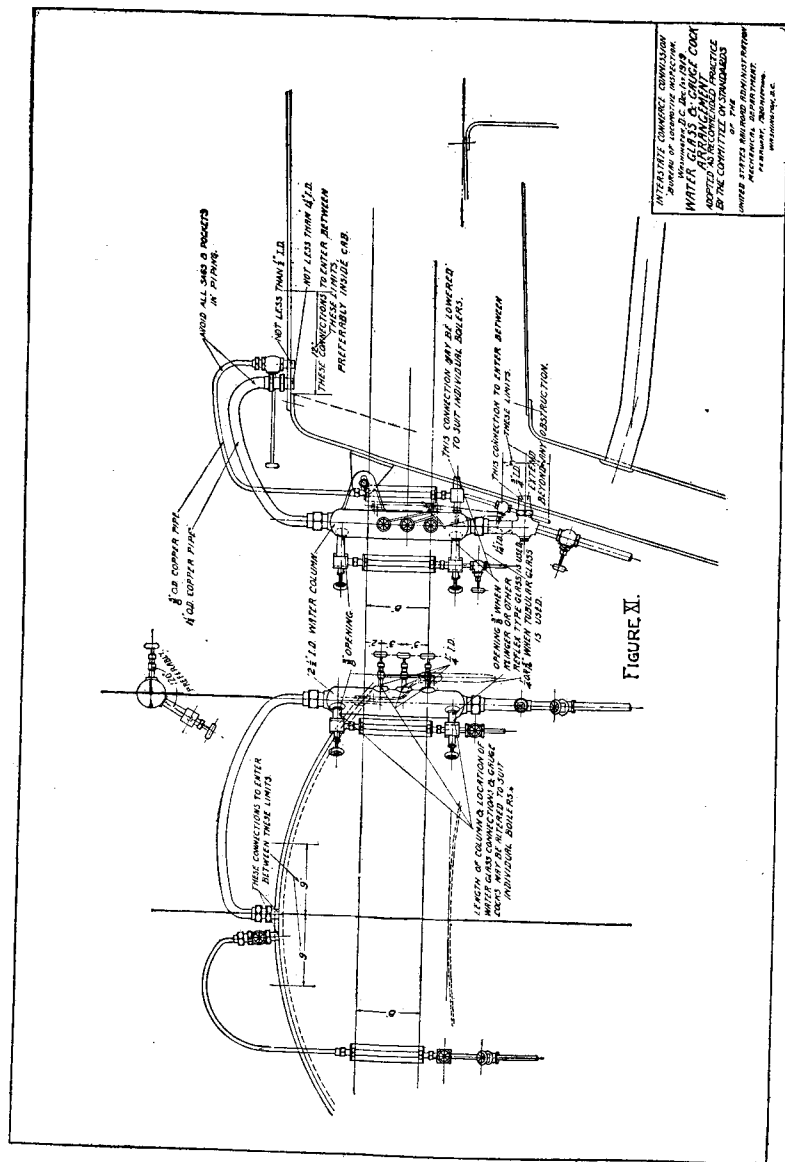


FIGURE 11.

This arrangement has been recommended by this bureau and was adopted as recommended practice by the committee on standards of the United States Railroad Administration at its February, 1920, meeting. To this water column three gauge cocks and one water

glass are shown attached; one water glass applied in the usual manner on the left side of boiler head for the purpose of forming a double check of the height of water over the crown sheet and to broaden the view from different parts of the cab.

SIZE AND LOCATION OF OPENINGS AFFECTS READINGS.

In constructing and applying the water column, the ratio of openings between top and bottom connections, as indicated by figure 11, should be retained, and the bottom connection screwed into the boiler far enough to pass all obstructions which may be immediately above them. It was illustrated in the fifth series of tests that when the bottom connection to the column entered the boiler head 1 inch past flush, and directly under a vertical T iron, it caused the water to rise 1 inch in the column glass, but when extended past the T iron the readings in all glasses corresponded.

The larger connection to the top of the column, and restricted openings in the gauge cocks, which should be not more than one-fourth inch in diameter, are for the purpose of preventing the water from being raised when the gauge cock is opened wide, the object being to compensate for the lowering pressure in the column through the larger top connection, the area of the smallest openings of which should be not less than 1 1/2-inch copper pipe, or preferably larger.

Very recent tests indicate that to avoid the possibility of inaccurate readings due to raising the water in the column when the gauge cocks are opened excessively wide, the inside diameter of the column be made 3 1/2 inches and that of the top connection 2 inches. Experiments with column and steam pipe of these dimensions and three-fourths-inch opening in the bottom connection showed that the water in the column glass could not be raised, by opening the gauge cock, to exceed one-fourth inch, regardless of the amount or length of time the gauge cocks were open.

It is recommended that the bottom water-glass cock and bottom connection to the water column enter the boiler horizontally, and that the water column and water glasses stand vertical.

TRAPS SERIOUSLY AFFECT READINGS.

Steam-pipe connections to water columns and water glasses should be made as short as possible so as to obtain a supply of dry steam at all times, and so arranged as to thoroughly drain and be free from short ends or any possibility of sags or traps. It has been definitely established that where traps or sags that will retain the water of condensation are permitted in the top connection to water glasses or water columns, the reading of the water is materially affected, causing a higher level to be indicated.

When water glasses are in proper condition to correctly register the water in the boiler, the water is never at rest while under pressure, and when the water becomes slow or sluggish of movement or in agitation, it indicates an improper condition that should be immediately corrected. Such conditions are usually caused by restriction in the openings in the fixtures, sags or traps in the steam-pipe connection or the top connection made so as to allow water to enter and sometimes by bottom connection being improperly located so as to permit steam bubbles to enter or the column to be affected by the circulation.

The water-indicating and feed-water appliances are among the most important devices on the locomotive, from the view point of safety as well as economy; therefore, every effort should be made to see that they are so constructed, applied and maintained as to properly perform their functions under all conditions of service, and that the water-indicating appliances are so located that the engine-men operating the locomotive may have the widest and easiest possible view from their usual and proper positions in the cab.

During the period of Federal control, the Assistant Director of Operation, United States Railroad Administration, was furnished monthly a statement showing in detail all defects found on locomotives operating under the jurisdiction of the Railroad Administration, which constituted violations of the law and rules, and those ordered out of service, as provided in section 6 of the law. In addition to this, a number of special investigations were made at the request of the Railroad Administration, and reports furnished covering conditions found and action taken. In this and in other ways, this bureau cooperated with the Railroad Administration during Federal control to the fullest extent consistent with the purpose of the law.

In connection with the transportation act of 1920, and other matters, it was necessary for the commission to require the services of the Bureau of Locomotive Inspection in making certain important investigations, and to perform other important duties.

So that authentic information might be obtained relative to the refrigeration of vegetables and fruits enroute from the South to the Northern markets, a number of the inspectors were employed in making special investigations and compiling reports covering various icing stations in the Southeast.

In addition to this, the entire force of the Bureau were called upon to assist in relieving the car congestion at various terminals and gateways throughout the country, which so seriously threatened the transportation and shipping interests. In this and other ways valuable service was unquestionably rendered to the Government, the traveling and shipping public, as well as the carriers. The inspectors of this bureau spent an aggregate of 2,439 days, or the approximate

equal of eight inspectors for the entire year, making such investigations.

Section 7 of the act of February 17, 1911, amended March 4, 1915, requires, in addition to the annual report of the chief inspector to the Interstate Commerce Commission, that he shall make such recommendations for the betterment of the service as he may desire.

In accordance with this, I desire to renew certain recommendations which were made in my eighth annual report, which are herewith restated and the reasons therefor given.

First. That the act of February 17, 1911, be amended so as to provide for additional inspectors, to be appointed by the commission, upon the recommendation of the chief inspector, as the needs of the service develop.

The act of February 17, 1911, provides that 50 inspectors be appointed, whose duties shall be to make such personal inspections from time to time of locomotive boilers under their care as might be necessary to fully carry out the provisions of the act, so that the locomotives might be employed in moving traffic without unnecessary peril to life or limb, at which time there were approximately 63,000 locomotives in service coming under the jurisdiction of the law.

Since this act was established it has been amended, extending the authority of the chief inspector and his two assistants, together with all of the district inspectors, to cover the entire locomotive and tender and all of their appurtenances, and the number of locomotives in service has increased approximately 11 per cent. With the extended duties of the inspectors and the increase in the number of locomotives in service it is impossible for the number now provided to adequately accomplish the purpose for which the law was established.

New duties and responsibilities have been imposed upon the commission by the transportation act of 1920, and no doubt in the future, in the immediate past, this bureau will be called on from time to time to assist in making many investigations necessary to fully carry out the requirements.

To be in position to do this it will be necessary to have an efficient corps of competent and well-trained inspectors who can be called upon when occasion requires. In order to obtain and retain in the service such inspectors, it will be necessary to increase their salaries so as to be commensurate with the duties performed and the responsibilities carried. The absence of inspectors from their accustomed duties or the lack of sufficient number to fully cover the situation is soon reflected by the increased number of accidents and casualties and the deficiencies in the condition of motive power. It is, therefore, respectfully recommended that the act of February 17, 1911, be amended so as to provide for additional inspectors to be appointed by the commission, upon the recommendation of the chief inspector,

as the needs of the service develop, and so that adequate salaries may be paid to the inspectional force that will obtain and retain in the service a full corps of well-trained, efficient inspectors, and that the amounts directly appropriated to carry out the provisions of the act of February 17, 1911, as amended, be increased in accordance with this.

Second. That all locomotives not using oil for fuel have a mechanically operated fire door, so constructed that it may be operated by pressure of the foot on a pedal or other suitable device, located on the floor of the cab or tender, at a proper distance from the fire door, so that it may be conveniently operated by the person firing the locomotive.

This recommendation is based on the results of many investigations of boiler failures of such character as to permit the steam and water contained in the boiler at the time of the accident, to be discharged into the firebox, many times being directed toward the fire door.

The old swing type door, which is largely used at present is almost invariably blown open, in case of such accidents, and permits the discharging steam and boiling water, with the contents of the fire box, to be blown into the cab of the locomotive, seriously and most frequently scalding and burning the persons therein. Such accidents frequently occur while coal is being put into the fire box, and with the fire door necessarily open, under such circumstances it is impossible for it to be closed.

The automatic fire door would remain closed, if closed when the accidents occur. If open, it would automatically close, the moment the operator's foot was removed from the operating device thus preventing the direct discharge of the scalding water and fire into the cab of the locomotive, with such serious results.

The automatic fire door is not a new and untried device, as there are thousands of them in service, and they are required by law in some States. The automatic fire door is also of great value in prevention of serious cracks and leaks in fire box sheets, by limiting the time fire doors are open when placing coal on the fire, thus reducing the amount of cold air admitted, which causes loss of temperature, and consequent expansion and contraction, and the setting up of great strains.

Their use is also very valuable in the conservation of fuel, which is, at the present time, a most important item.

Third. That all locomotives be provided with a bell so arranged and maintained that it may be operated from the engineer's cab by hand and by power.

The reason for this recommendation has been thoroughly discussed on previous occasions, and its necessity seems so apparent

that it hardly requires further comment. We believe, however, that this is an appliance which is vital to the safety of the employees and general public at highways and other public places where the railroads traverse. The operation of modern motive power demands the full attention of the enginemen, and it is frequently the case, while passing over road crossings and through congested territories, that the operators are so occupied with their other important duties that it is impossible for them to ring a bell by hand, in order to give warning of approaching danger.

Fourth. That cabs of all locomotives not equipped with front doors or windows of such size as to permit of easy exit, have a suitable stirrup or other step, and a horizontal handhold on each side, approximately the full length of the cab, which will enable the enginemen to go from the cab to the running board in front of it; handholds and steps or stirrups to be securely fastened with bolts or rivets; the distance between the step and handhold to be not less than 60 inches or more than 72 inches.

This recommendation is based on the result of investigation of accidents of a character which make it impossible for enginemen to remain in the cab and which compel them to make exit through the cab window to the ground or running board. While locomotives are operating at a high speed, to be compelled to jump from the cab window is exceedingly dangerous, and invariably results in serious or fatal injury.

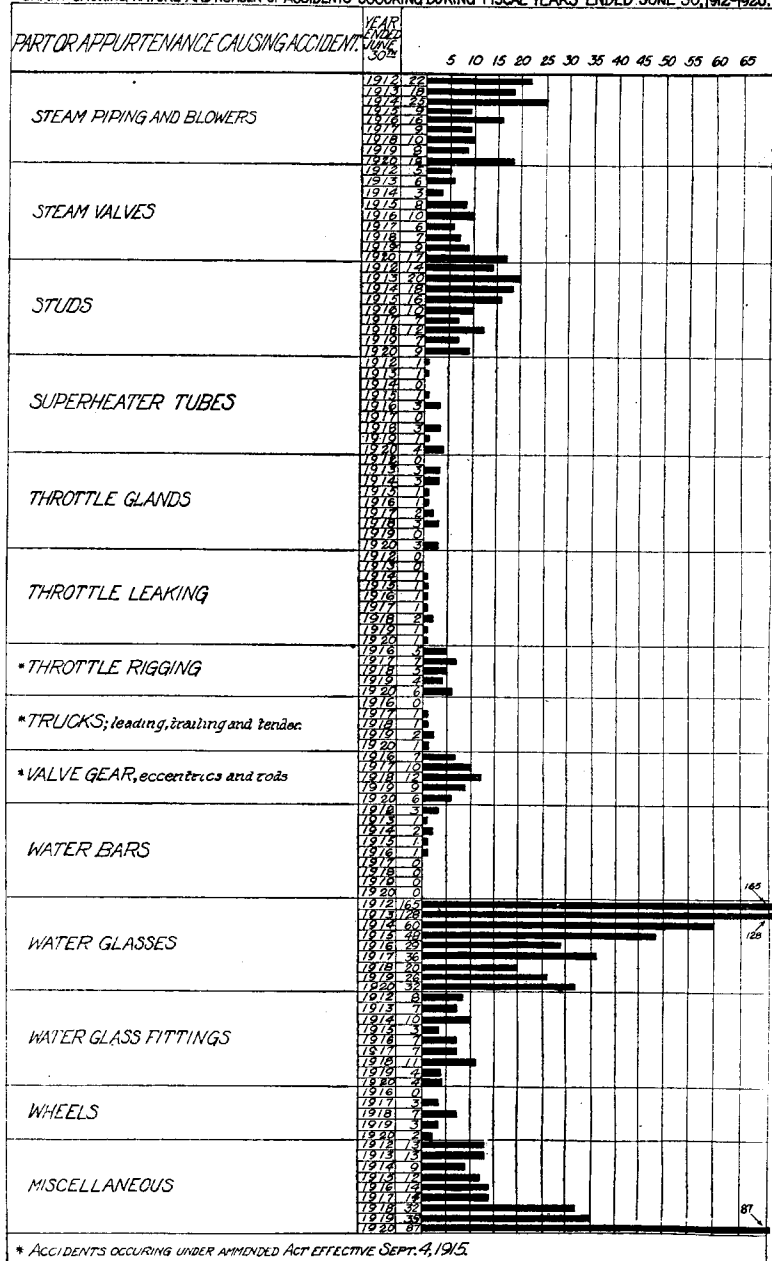
The front doors or windows on modern locomotives are so small that they will not permit the enginemen to pass out through them, thus making it necessary to climb over the roof of the cab or out through the side window, when necessary to go from the cab to running board in front while in motion.

Such arrangements can be applied at a nominal expense and practically without delay to the locomotive, and would add greatly to the safety of the employees. Accidents resulting in fatal injury, which have been investigated by this Bureau, show that injury and death would have been avoided had these appliances been in use.

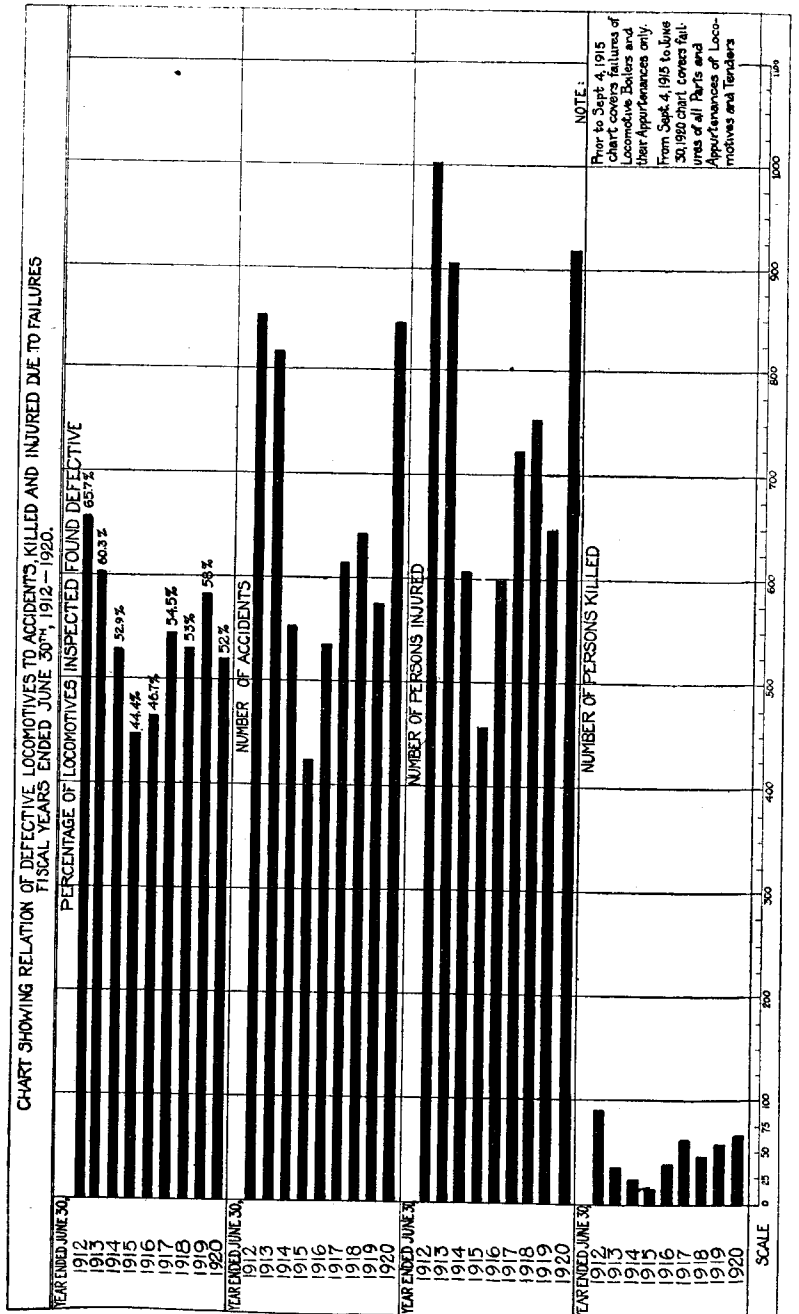
A great number of locomotives in service at this time have been equipped with the appurtenances above recommended, although like many other appliances in use, they are not maintained in a proper condition for service.

Fifth. That all locomotives where there is a different indication between the gauge cock and water glass of 2 or more inches of the water level under any conditions of service be equipped with a suitable water column to which shall be attached three gauge cocks and one water glass with not less than 6 inches, preferably 8 inches, clear reading, and one additional water glass with not less

CHART SHOWING NATURE AND NUMBER OF ACCIDENTS OCCURRING DURING FISCAL YEARS ENDED JUNE 30, 1912-1920.



* ACCIDENTS OCCURRING UNDER AMENDED ACT EFFECTIVE SEPT. 4, 1915.



NOTE:
Prior to Sept. 4, 1915 chart covers failures of Locomotive Boilers and their Appurtenances only. From Sept. 4, 1915 to June 30, 1920 chart covers failures of all Parts and Appurtenances of Locomotives and Tenders.

SCALE

Accidents and casualties resulting from failures of locomotives and tenders and their appurtenances.

Part or appurtenance which caused accident.	Year ended June 30—											
	1920			1919			1918			1917		
	Accidents.	Killed.	Injured.	Accidents.	Killed.	Injured.	Accidents.	Killed.	Injured.	Accidents.	Killed.	Injured.
Air reservoirs.....	2	1	2	2	.....	2	5	.....	7	4	1	4
Aprons.....	8	.....	8	5	.....	5	5	.....	5	6	.....	6
Arch tubes.....	9	1	15	7	2	9	9	.....	16	9	.....	15
Ash-pan blowers.....	6	1	5	11	1	10	7	.....	7	7	1	6
Axles.....	5	.....	5	2	.....	2	4	.....	4	7	.....	11
Blow-off cocks.....	15	.....	15	4	.....	4	17	1	18	22	.....	23
Boiler checks.....	5	.....	6	4	.....	4	13	.....	14	13	.....	13
Boiler explosions:												
A. Shell explosions.....										1	2	8
B. Crown sheet; low water; no contributory causes found.....	24	22	35	31	26	46	34	15	61	38	30	66
C. Crown sheet; low water; contributory causes or defects found.....	35	19	46	34	13	63	51	17	82	23	15	32
D. Fire box; defective stay bolts, crown stays, or sheets.....	2	.....	2	2	.....	3	5	.....	6	2	.....	2
E. Fire box; water foaming.....												
Brakes and brake rigging.....	3	.....	3	8	.....	10	2	.....	2	1	.....	1
Couplers.....	8	.....	8	12	.....	14	6	2	4	4	1	3
Crank pins, collars, etc.....	4	.....	4	5	.....	6	7	.....	9	6	2	4
Crossheads and guides.....	5	2	3	5	.....	5	1	.....	1	1	.....	2
Cylinder cocks and rigging.....				2	.....	2	2	.....	2	1	.....	1
Cylinder heads and steam chests.....	9	.....	9	5	.....	7	4	.....	4	6	2	7
Dome caps.....	1	.....	1	2	.....	4	1	.....	1	.....	.....	.....
Draft appliances.....	11	2	9	7	1	6	11	2	9	15	1	14
Draw gear.....	11	.....	11	7	.....	7	6	.....	6	5	.....	5
Fire doors, levers, etc.....	45	.....	52	33	1	39	40	.....	47	50	.....	60
Flues.....				2	.....	2	2	.....	2	2	.....	2
Flue pockets.....	23	.....	23	7	.....	7	7	.....	7	8	.....	8
Footboards.....	2	.....	2	.....	.....	.....	1	.....	1	.....	.....	.....
Gauge cocks.....	10	.....	10	3	.....	3	1	.....	2	3	.....	3
Grease cups.....	108	.....	109	37	1	36	39	.....	39	51	.....	51
Grate shakers.....	15	1	14	16	1	15	15	1	14	15	.....	15
Handholds.....	9	1	9	4	.....	5	9	.....	10	8	1	7
Headlights and brackets.....												
Injectors and connections (not including injector steam pipes).....	23	.....	27	21	.....	22	23	.....	24	18	.....	19
Injector steam pipes.....	23	1	29	14	.....	20	16	.....	18	16	1	18
Lubricators and connections.....	14	.....	15	11	.....	13	12	.....	12	11	1	12
Lubricator glasses.....	17	.....	17	9	.....	9	12	.....	12	13	.....	13
Patch bolts.....												
Pistons and piston rods.....	3	1	3	2	.....	2	2	.....	2	4	.....	4
Plugs, arch tube and wash-out.....	28	.....	40	30	1	34	14	2	19	8	.....	12
Plugs in fire-box sheets.....	1	.....	2	2	1	1	3	.....	3	1	.....	1
Reversing gear.....	59	.....	59	31	.....	31	40	.....	40	29	.....	29
Rivets.....				2	.....	2	3	.....	3	4	.....	4
Rods (main and side).....	16	2	20	14	.....	15	18	.....	22	17	.....	20
Safety valves.....				1	.....	1	1	.....	1	1	.....	1
Sanders.....	1	.....	1	.....	.....	.....	2	.....	2	1	.....	1
Side bearings.....												
Springs and spring rigging.....	9	2	18	5	2	4	7	.....	7	6	.....	6
Squirt hose.....	82	.....	82	54	.....	54	47	.....	50	69	.....	70
Stay bolts.....	2	2	1	2	.....	2	6	.....	8	3	.....	5
Steam piping and blowers.....	18	1	19	8	.....	11	10	.....	11	9	1	13
Steam valves.....	17	.....	17	9	.....	10	7	.....	17	6	1	5
Studs.....	9	.....	11	7	.....	9	12	.....	13	7	.....	11
Superheater tubes.....	4	.....	6	1	.....	1	3	.....	4	.....	.....	.....
Throttle glands.....	3	.....	4	.....	.....	.....	3	.....	3	2	.....	2
Throttle leaking.....	1	1	.....	1	.....	1	2	.....	2	1	.....	1
Throttle rigging.....	6	.....	6	4	.....	1	7	.....	5	7	.....	10
Trucks—leading, trailing, or tender.....	1	3	1	2	1	2	1	.....	1	1	.....	18

Accidents and casualties resulting from failures of locomotives and tenders and their appurtenances—Continued.

Part of appurtenance which caused accident.	Year ended June 30—											
	1920			1919			1918			1917		
	Accidents.	Killed.	Injured.	Accidents.	Killed.	Injured.	Accidents.	Killed.	Injured.	Accidents.	Killed.	Injured.
Valve gear, eccentrics and rods.....	6	.....	6	9	.....	9	12	.....	12	10	.....	11
Water bars.....												
Water glasses.....	32	.....	32	26	.....	26	20	.....	20	36	.....	37
Water-glass fittings.....	4	.....	4	4	.....	4	11	.....	11	7	.....	7
Wheels.....	2	1	4	3	.....	3	5	.....	5	3	.....	3
Miscellaneous.....	87	2	86	35	2	35	32	.....	32	43	.....	14
Total.....	843	66	916	565	57	647	641	46	756	616	62	721

[A star (*) indicates accidents taken from records of the Bureau of Statistics of the Interstate Commerce Commission. A double star (**) indicates accidents not properly reported, as required by rules 55 and 162. A complete investigation, therefore, could not be made, inasmuch as this bureau was not apprised of the accidents in sufficient time after they occurred to permit them to be properly investigated.]

ALABAMA & VICKSBURG RAILWAY:
 August 16, 1919, locomotive 444, Dixon, Miss. Valve blew off squirt hose pipe; defective threads on pipe; 1 injured.
 One accident; 1 injured.

ANN ARBOR RAILROAD:
 * January 13, 1920, locomotive 171, Owasso, Mich. Seat box in cab gave way; 1 injured.
 One accident; 1 injured.

ATCHISON, TOPEKA & SANTA FE RAILROAD:
 July 11, 1919, locomotive 715, Wickenburg, Ariz. Sight register glass and gland of lubricator blew out due to loose fit and defective threads on gland; 1 injured.

** August 8, 1919, locomotive 1138, near South Wichita, Kans. Flue broke; 1 injured.

August 21, 1919, locomotive 1964, Richmond, Calif. Pilot step gave way, due to hanger breaking at weld; 1 injured.

August 29, 1919, locomotive 1834, near Ponemah, Ill. Bonnet of intermediate throttle to mechanical coal passer blew out, due to loose fit of bonnet in valve body; 1 injured.

* September 10, 1919, locomotive 494, Kingman, Kans. Squirt hose blew off; 1 injured.

October 27, 1919, locomotive 1091, Ethel, Mo. Injector steam pipe failed at spanner nut connection, due to spanner nut being too large; 1 injured.

December 7, 1919, locomotive 3020, Thorn, Calif. Injector steam pipe union connection at injector throttle broke; union nut constructed of too light material, and was damaged by use of hammer and set in tightening at previous times; 1 injured.

* December 22, 1919, locomotive 3307, near Clovis, N. Mex. Hand rail on locomotive came loose; defective hand rail; 1 injured.
 * December 29, 1919, locomotive 1138, Sawyer, Kans. Handhold on engine loose, permitting engineer to fall; 1 injured.
 January 4, 1920, locomotive 1986, Mojave, Calif. Water glass burst; cut by flying glass; 1 injured.
 January 5, 1920, locomotive 374, Larned, Kans. Crown sheet failure; low water; no contributory causes found; 1 injured.
 ** January 18, 1920, locomotive 3190, near Ethel, Mo. Shaker bar slipped off lever, due to improper fit; 1 injured.

**February 4, 1920, locomotive 3183, near Argyle, Mo. Shaker bar slipped off lever, due to improper fit of bar on lever; 1 injured.

**March 8, 1920, locomotive 744, Frontenac, Kans. Water glass broke; cut by flying glass; 1 injured.

*May 8, 1920, locomotive 5 (G. C. & S. F.), Water Valley, Tex. Side rod broke and one end forced up through floor of cab; 2 injured.

May 31, 1920, locomotive 3121, Emporia, Kans. Injector delivery pipe failed at nipple at boiler check cage; nipple too small for opening in cage; 1 injured.

*June 9, 1920, locomotive 342, Lawrie, Okla. Running light engine for repairs account cylinder head having been knocked out on left side and main rod was down; right back side rod broke, damaging cab of engine; 1 injured.

*June 12, 1920, locomotive 1003, Siega, N. Mex. Valve stem broke, causing reverse lever to fly back and strike engineer; 1 injured.

Eighteen accidents; 19 injured.

ATLANTA, BIRMINGHAM & ATLANTIC RAILWAY:

*June 2, 1920, locomotive 107, Talbotton, Ga. Cylinder head blew out; 1 injured.

One accident; 1 injured.

ATLANTIC COAST LINE RAILROAD:

July 5, 1919, locomotive 465, Charleston, S. C. Crown sheet failure; low water; handle missing from drain valve to water glass; bottom opening of water glass almost stopped up by sediment; 1 killed, 1 injured.

*July 9, 1919, locomotive 278, Johns Island, S. C. Throttle packing blew out; 1 injured.

July 20, 1919, locomotive 800, Donaldsonville, Ga. Crown sheet failure; low water; no contributory causes found; 1 injured.

*August 8, 1919, locomotive 365, Waycross, Ga. Bolt in ash pan lever broke; 1 injured.

December 19, 1919, locomotive 324, near Walterboro, S. C. Flue broke at weld; defective butt weld; 2 injured.

December 26, 1919, locomotive 819, Drivers, N. C. Hand hold broke off at bottom end, causing brakeman to fall; old fracture at point of failure; 1 injured.

January 20, 1920, locomotive 328, Parmele, N. C. Injured while operating ash pan damper, due to lack of clearance between lever and tail brace of locomotive; 1 injured.

January 26, 1920, locomotive 90, Mount Holly, S. C. Glass fell out of cab window, due to defective sash; 1 injured.

February 7, 1920, locomotive 379, Barnes Still, Ga. Crown sheet failure; low water; nine broken radial stays (two being adjacent in two different places); accumulation of coal in left tank hose; autogeneously welded seam connecting right side sheet to crown sheet failed (engineer, weighing over 200 pounds, was uninjured, as he swung out of cab window, holding onto handhold attached to top side of cab); 2 injured.

*February 11, 1920, locomotive 343, Greenville, N. C. Stop pin missing in back end of reverse lever quadrant, allowing reverse lever to strike wall of cab, injuring engineer's hand; 1 injured.

February 18, 1920, locomotive 978, Marion, S. C. Left main driving axle broke; axle had been drilled and plugged to tighten wheel on axle; fracture occurred at bottom of pin holes; 1 injured.

March 22, 1920, locomotive 457, Florence, S. C. Pilot sill step brace became loose, due to nut working off, allowing brace to drop down and catch on road-bed; 1 injured.

April 5, 1920, locomotive 156, South Rocky Mount, N. C. Bolts holding driver brake fulcrum broke, allowing brake rigging to fall down and strike ash pan blower pipe, breaking off ash pan blower valve; fulcrum was reported loose on day previous to accident; 1 injured.

April 12, 1920, locomotive 182, Wilmington, N. C. Lubricator glass burst; shield removed at time of accident; 1 injured.

May 15, 1920, locomotive 1134, South Richmond, Va. Coupler pocket pin on front end of locomotive broke; pin made of inferior grade of iron; 1 injured.

May 30, 1920, locomotive 188, South Rocky Mount, N. C. Reverse lever jumped out of quadrant, due to latch spring guide working out of latch; 1 injured.

June 5, 1920, locomotive 991, Charleston, S. C. Squirt hose blew off; hose insecurely clamped; 1 injured.

*June 11, 1920, locomotive 454, Wiley, Ala. Drawbar between engine and tender broke while engine was running at a speed of 25 miles per hour, causing fireman to fall between engine and tender; 1 injured.

June 12, 1920, locomotive 1137, Jacksonville, Fla. Squirt hose pipe nipple broke; defective nipple; 1 injured.

*June 16, 1920, locomotive 1294, McIntosh, Ga. Scalded by steam and hot water from blower pipe, due to defective pipe; 1 injured.

Twenty accidents; 1 killed, 22 injured.

BALTIMORE & OHIO RAILROAD.

August 15, 1919, locomotive 2657, near Waverly, W. Va. Crown sheet failure; low water; no contributory causes found; 1 injured.

**August 30, 1919, locomotive 2747, New Castle Junction, Pa. Ventilator fell off of cab roof, due to not being fastened in place; 1 injured.

August 30, 1919, locomotive 1766, Clarksburg, W. Va. Washout plug blew out; attempted to tighten under pressure; plug insecurely applied; 1 injured.

August 31, 1919, locomotive 2583, Cumberland, Md. Squirt hose pipe nipple blew out; threads wasted away, due to corrosion; 1 injured.

**September 6, 1919, locomotive 2278, Willard, Ohio. Headlight fell off, due to nuts coming off bolts; 1 injured.

September 7, 1919, locomotive 2669, Seymour, Ind. Piston rod broke at cross-head fit through keyway, knocking out front cylinder head; old fracture in rod at keyway; 1 injured.

**September 15, 1919, locomotive 1604, Pittsburgh, Pa. Reserve lever slipped out of quadrant; teeth in quadrant worn; 1 injured.

**September 15, 1919, locomotive 1353, Sherman, W. Va. Chain provided between side of locomotive cab and tender became unhooked while locomotive was running at a speed of 20 miles per hour, permitting fireman to fall out of gangway; hook of improper design, and chain 4 inches too long; 1 injured.

September 18, 1919, locomotive 1514, Ellwood City, Pa. Nut blew off throttle gland while attempting to tighten; threads on nut defective, and nut showed evidence of use of hammer and chisel in tightening at previous times; 1 injured.

**September 19, 1919, locomotive 5117, near Clay City, Ill. Ventilator fell off back of cab, due to defective fastenings; 1 injured.

September 25, 1919, locomotive 2895, Dillon, Ohio. Injured while using squirt hose; valve leaking, due to cut seat; 1 injured.

November 5, 1919, locomotive 5019, near Hughey, Ill. Injector steam pipe collar pulled out of flange connection, due to improper design; outside diameter of flange on collar only $\frac{1}{8}$ -inch larger than opening in flange coupling; 1 injured.

November 9, 1919, locomotive 2269, Outville, Ohio. Crown sheet failure; low water; no contributory causes found; 3 injured.

**November 13, 1919, locomotive 5136, Willard, Ohio. Handrail on Vanderbilt type tender pulled out at union, causing employee to fall; handrail entirely broken off at front end (old break), and threads in union connection engaged handrail only two threads; 1 injured.

November 25, 1919, locomotive 1726, Lima, Ohio. Flue broke at weld; overheated in welding; 1 injured.

December 16, 1919, locomotive 4198, near New Castle, Pa. Crown sheet failure; low water; appurtenances destroyed to such extent at time of accident that their previous condition could not be determined; 13 radial stays found broken; crown sheet flue sheet welded seam failed its entire length; failure of defectively welded seams in crown sheet unquestionably contributed to the seriousness of the accident; 2 killed, 1 injured.

*December 19, 1919, locomotive 1155, Baltimore, Md. Squirt hose blew off; insecurely clamped; 1 injured.

December 24, 1919, locomotive 4324, near Shelby Junction, Ohio. Valve applied to dome for purpose of blowing down boiler, broke off at nipple connection to dome; 1 injured.

December 27, 1919, locomotive 7210, Grafton, W. Va. Crown sheet failure; low water; no contributory causes found; 1 killed, 1 injured.

January 4, 1920, locomotive 1690, near Wayland, Ohio. Shaker bar slipped off lever, due to improper fit; 1 injured.

**January 7, 1920, locomotive 2535, Laughlin Junction, Pa. Injured while operating shaker bar; 1 injured.

January 7, 1920, locomotive 5004, Lavenia, Pa. Lubricator steam pipe broke off at lubricator connection; old fracture in pipe; 1 injured.

February 15, 1920, locomotive 4250, Warwick, Ohio. Grease cup plug blew out while attempting to remove plug on main side rod connection; inspection report filed just after completion of last trip prior to accident states "Right main side rod bushing running very hot; can not get grease on pin"; 1 injured.

February 28, 1920, locomotive 7202, Strickers, Md. Cast-iron smokestack extension became disconnected at stack base, dropping down on one side, causing back draft; 1 injured.

March 13, 1920, locomotive 4562, Riverside, Md. Bull's-eye lubricator glass blew out; 1 injured.

** April 4, 1920, locomotive 1965, Philadelphia, Pa. Section of handrail became disconnected; 1 injured.

April 12, 1920, locomotive 1372, Varners, W. Va. Gangway chain became unhooked, permitting fireman to fall from locomotive while moving at a speed of 15 miles per hour; excessive slack in chain and excessive opening in hook; 1 injured.

May 21, 1920, locomotive 2309, Pittsburgh, Pa. Water glass burst; cut by flying glass; 1 injured.

May 29, 1920, locomotive 2638, Wildwood, Pa. Shaker rod bolt broke while attempting to shake grates; 1 injured.

June 2, 1920, locomotive 4547, Sewell, Md. Injured while operating shaker bar, due to section of grates becoming disconnected; 1 injured.

** June 4, 1920, locomotive 4550, Lima, Ohio. Injured while shaking grates; due to connecting rod pin breaking; 1 injured.

June 4, 1920, locomotive 2573, St. James Station, Pa. Right front side rod failed, derailing locomotive; old defect in rod; 3 injured.

June 13, 1920, locomotive 2302, Clokey Siding, Pa. Crown sheet failure; low water; gauge cock drip stopped up, and bottom gauge cock nipple extended into water space in drip pan; 4 injured.

Thirty-three accidents; 3 killed, 40 injured.

BANGOR & AROOSTOOK RAILROAD:

* September 22, 1919, locomotive 67, Washburn, Me. Flue burst; 1 injured.

October 22, 1919, locomotive 232, South La Grange, Me. Crown sheet failure; low water; top and bottom water glass fittings obstructed by pieces of gaskets; 1 injured.

* December 22, 1919, locomotive 230, Houlton, Me. Side rod on engine broke; 1 injured.

Three accidents; 3 injured.

BESSEMER & LAKE ERIE RAILROAD:

August 7, 1919, locomotive 134, Coolspring, Pa. Left back-up eccentric and strap broke, causing reverse lever to unlatch and go into forward position, striking engineer; 1 injured.

November 6, 1919, locomotive 507, Hewitt, Pa. Crown sheet failure; low water; no contributory causes found; appurtenances destroyed and damaged to such extent that their previous condition could not be determined; 3 killed.

Two accidents; 3 killed, 1 injured.

BOSTON & ALBANY RAILROAD:

** September 11, 1919, locomotive 1042, near Springfield, Mass. Key came out of tumbling shaft arm, allowing tumbling shaft to drop down, forcing right link block down, causing locomotive to move backward instead of forward; 1 killed.

October 2, 1919, locomotive 1043, Rensselaer, N. Y. Bull's-eye lubricator glass blew out; 1 injured.

March 2, 1920, locomotive 3703 (N. Y. C.), near Canaan, N. Y. Crown sheet failure; low water; top gauge cock inoperative; top of water glass partially stopped up by rubber gasket; pocket in top connection of water glass; 1 injured.

** June 11, 1920, locomotive 512, near Framingham, Mass. Extension blower pipe parted at union, due to pipe becoming loose; 1 injured.

Four accidents; 1 killed, 3 injured.

BOSTON & MAINE RAILROAD:

* July 3, 1919, locomotive 2045, Rawley, Mass. Eccentric strap broke, causing reverse lever to fly out of quadrant; old defect in eccentric strap; 1 injured.

July 5, 1919, locomotive 3603, East Deerfield, Mass. Injured while operating valve to steam-heat gauge, due to hole worn in steam-heat gauge pipe; 1 injured.

August 14, 1919, locomotive 2726, Baldwinville, Mass. Shaker bar slipped off lever, due to improper fit; 1 injured.

September 22, 1919, locomotive 953, near Burt, Mass. Grate support stud blew out; defective threads in sheet; 1 injured.

October 15, 1919, locomotive 2338, West Kennebunk, Me. Flue broke at safe end weld; excessive accumulation of scale on flue; 1 injured.

October 21, 1919, locomotive 1497, near Lake Pleasant, Mass. Locomotive stripped; 1 injured.

October 29, 1919, locomotive 2104, near Tyngsboro, Mass. Crown sheet failure; low water; bottom water glass cock found closed at time of investigation. Work report for October 27 shows, "Water glass works slowly"; work report for October 28 shows, "Lower water glass valve wants cleaning out"; 1 injured.

November 4, 1919, locomotive 948, near Waltham, Mass. Flue broke at weld; overheated in welding; flue badly corroded on inside; 1 injured.

November 21, 1919, locomotive 2666, East Deerfield, Mass. Iron plate missing from tender sill step, and step worn, permitting engineer to fall; 1 injured.

November 26, 1919, locomotive 373 (N. Y., N. H. & H.), near Rollingsford, N. H. Lubricator steam pipe blew off; 1 injured.

December 19, 1919, locomotive 2400, near Wayland, Mass. Shaker bar became disconnected, due to pin coming out of end of shaker staff; 1 injured.

December 27, 1919, locomotive 27, near Enfield, N. H. Injured while operating shaker bar; eye in shaker staff broken; defect reported December 16, 23, and 25, and repairs not made; 1 injured.

December 29, 1919, locomotive 1028, Springfield, Mass. Expansion pad stud blew out; threads on stud badly corroded, and stud screwed into sheet only one-fourth inch; 1 injured.

February 14, 1920, locomotive 3606, East Northfield, Mass. Injured while operating shaker bar, due to bolt coming out of lever where connected to grates in ash pan; 1 injured.

February 16, 1920, locomotive 2024, near Wing Road, N. H. Loose bolt in step on leg of tender, causing fireman to fall; 1 injured.

March 3, 1920, locomotive 1404, Concord, N. H. Injured while operating shaker bar, due to pin at bottom of post shearing off; 1 injured.

March 4, 1920, locomotive 8667, near Salmon Falls, Mass. Shaker bar slipped off lever, due to improper fit; 1 injured.

April 2, 1920, locomotive 2321, near Oliverian, N. H. Shaker bar slipped off lever; improper fit; 1 injured.

April 17, 1920, locomotive 2908, near Nashua, N. H. Shaker bar broke; 1 injured.

April 22, 1920, locomotive 3664, near East Kingston, N. H. Eye of coal door hinge worn through, allowing door to drop down; 1 injured.

June 14, 1920, locomotive 2903, near Martin, N. H. Shaker bar slipped off, due to improper fit; 1 injured.

June 27, 1920, locomotive 2604, Greenfield, Mass. Shaker bar slipped off lever, due to improper fit; bar badly worn; 1 injured.

Twenty-two accidents; 22 injured.

BUFFALO & SUSQUEHANNA RAILROAD:

* January 20, 1920, locomotive 133, Sagamore, Pa. Grease cup cap flew off, due to emptying contents of fusee into grease cup to cool hot pin; 1 injured.

One accident; 1 injured.

BUFFALO, ROCHESTER & PITTSBURGH RAILWAY:

* December 14, 1919, locomotive 165, Gainesville, N. Y. Lubricator steam pipe broke off; 1 injured.

One accident; 1 injured.

CANADIAN PACIFIC RAILWAY:

* June 21, 1920, locomotive 3530, Holeb, Me. Squirt hose blew off, due to bolt in clamp becoming loose; 1 injured.

One accident; 1 injured.

CAROLINA, CLINCHFIELD & OHIO RAILWAY:

* March 20, 1920, locomotive 306, Nora, Va. Union on left injector burst; 1 injured.

One accident; 1 injured.

CENTRAL NEW ENGLAND RAILWAY:

January 11, 1920, locomotive 11, Maybrook, N. Y. Injured while operating shaker bar, due to cotter pin working out of connecting rod pin; 1 injured.

One accident; 1 injured.

CENTRAL OF GEORGIA RAILWAY:

September 25, 1919, locomotive 1018, Acmar, Ala. Headlight turbine exploded, due to governor not being properly adjusted, and one turbine wheel hub spoke broken; 1 injured.

January 13, 1920, locomotive 1201, Bishop, Ga. Autogenously welded seam in crown sheet failed; defective and improper weld; 1 injured.

January 13, 1920, locomotive 1003, Mansfield, Ga. Right front tender truck spring seat broke and fell out of place, derailing tender truck; old break in spring seat; 1 injured.

Three accidents; 3 injured.

CENTRAL RAILROAD OF NEW JERSEY:

August 21, 1919, locomotive 404, Rockaway, N. J. Drop grate stud blew out of back head; threads on stud practically worn away; 1 injured.

September 9, 1919, locomotive 820, Philadelphia, Pa. Squirt hose parted at splice; hose insecurely clamped; 1 injured.

February 8, 1920, locomotive 281, Jersey City, N. J. Water glass burst; cut by flying glass; 1 injured.

Three accidents; 3 injured.

CENTRAL VERMONT RAILWAY:

* September 3, 1919, locomotive 327, Millers Falls, Mass. Injector overflow pipe blew off at injector connection, due to threads on union stripping; 1 injured.

One accident; 1 injured.

CHARLESTON & WESTERN CAROLINA RAILWAY:

* November 14, 1919, locomotive 112, Augusta, Ga. Lubricator glass burst; 1 injured.

One accident; 1 injured.

CHESAPEAKE & OHIO RAILROAD:

* July 4, 1919, locomotive 665, Olive Hill, Ky. Squirt hose blew off; 1 injured.

August 11, 1919, locomotive 83, Phoebus, Va. Main air reservoir exploded, due to rusting and wasting away on outside surface near longitudinal seam from a thickness of one-fourth inch to practically nothing at places, and at no place was sheet over one-sixteenth inch thick where it ruptured. Locomotive received classified repairs 51 days previous to accident, at which time annual locomotive inspection and repair report was filed indicating that reservoir had been hammer tested and given a hydrostatic test. It is very evident that a proper hammer test could not have been given, or even a casual observation, otherwise the defective conditions could easily have been discovered; 1 killed.

** October 6, 1919, locomotive 679, Catlett, Va. Air-supply pipe to left main reservoir broke; 1 injured.

November 9, 1919, locomotive 549, Peach Creek, W. Va. Low coupler on tender, causing locomotives, which were double-heading, to separate; 1 injured.

November 16, 1919, locomotive 556, Cincinnati, Ohio. Injector steam-pipe collar broke; collar improperly applied; brazing did not extend entire length of collar; 1 injured.

November 16, 1919, locomotive 323, near Peru, Ind. Drawbar pin broke, permitting locomotive and tender to separate, breaking eyebolt in right safety chain, and left safety chain eyebolt pulled through sill; drawbar pin badly crystallized; 1 injured.

January 7, 1920, locomotive 953, Melbourne, Ky. Arch tube pulled out of firebox throat sheet; arch tube not belled or beaded to secure it in place; tube entered sheet only one-fourth inch; 3 injured.

March 26, 1920, locomotive 250, near Hampton, Va. Left arch-tube nut or eye pulled out of crown sheet, due to being applied cross threaded, and entered sheet only two threads on one side and three threads on opposite side; fatally injured.

April 15, 1920, locomotive 680, Brownwood, W. Va. Injector steam-pipe collar broke; overheated in brazing; 1 injured.

May 28, 1920, locomotive 831, Marion, Ind. Squirt hose blew off; hose insecurely clamped; 1 injured.

Ten accidents; 1 killed, 11 injured.

CHICAGO & ALTON RAILROAD:

July 14, 1919, locomotive 808, Roodhouse, Ill. Water glass burst; protecting glasses of water-glass shield not in place at time of accident; 1 injured.

July 23, 1919, locomotive 96, East St. Louis, Ill. Fire hose burst; defective hose; 1 injured.

September 8, 1919, locomotive 61, Kansas City, Mo. Injured while shaking plates, due to shearing of pin at bottom end of shaker staff; 1 injured.

October 16, 1919, locomotive 318, East Peoria, Ill. Flue broke at weld; overheated in welding; 1 injured.

December 15, 1919, locomotive 61, Kansas City, Mo. Bushing screwed out of orificator while attempting to tighten filling plug; plug had right-handed threads, while bushing had left-handed threads; 1 injured.

January 13, 1920, locomotive 819, near Towanda, Ill. Flue broke at weld; hose improperly welded; 1 injured.

May 17, 1920, locomotive 430, near Gilliam, Mo. Reverse lever flew out of quadrant; new valve-motion bushings improperly fitted on valve-motion pins, causing them to heat and expand, gripping pins which caused reverse lever to go to back corner while locomotive was moving forward; 1 injured.

May 25, 1920, locomotive 883 (U. S.), near Venice, Ill. Crown sheet failure; water; left water glass inoperative, due to broken nipple in bottom connection; bottom cock of right water glass nearly closed by incrustation; middle gauge cock stuck shut. Welded seam connecting combustion chamber crown sheet to crown sheet proper failed for a distance of 40½ inches; 2 injured.

Eight accidents; 9 injured.

CHICAGO & NORTH WESTERN RAILROAD:

July 25, 1919, locomotive 1893, near Genoa Junction, Ill. Reverse lever became latched, due to weak latch spring; 1 injured.

* August 28, 1919, locomotive 1887, near Vial, Iowa. Injured while operating reverse lever; top gib missing from left valve crosshead; reverse lever latch ring would not hold reverse lever latch in quadrant; 1 injured.

September 6, 1919, locomotive 1745, Port Washington, Wis. Squirt hose parted at splice; 1 injured.

September 9, 1919, locomotive 645, Madison, Wis. Squirt hose blew off; hose insecurely clamped; daily inspection report for September 4 states "Put on squirt hose." Hose had not been renewed; 1 injured.

September 18, 1919, locomotive 1702, near De Kalb, Ill. Squirt hose blew off; hose not clamped; 1 injured.

September 24, 1919, locomotive 2067, Adams, Wis. Injured while operating reverse lever, due to counterbalance spring breaking; 1 injured.

September 26, 1919, locomotive 139, South Norfolk, Nebr. Crown sheet failure; water; one gauge cock stopped up; steam pipe connection at top end of water glass partially stopped up with fiber gasket; five radials broken, two of which were adjacent; work reports for three days preceding accident state union at top of water glass leaking. Autogenously welded seam between left crown sheet and crown sheet failed its entire length; 1 killed.

September 29, 1919, locomotive 513, New Ulm, Minn. Blowoff cock operating improperly connected, and not provided with safety latch for operating lever; handle rubbing on driver brake piston rod when brakes are applied, causing blow-off cock to open; blow-off cock leaking; 1 injured.

** October 11, 1919, locomotive 45, near Cecil, Wis. Driver spring hanger failed; 1 injured.

October 25, 1919, locomotive 17, Casper, Wyo. Heater pipe blew out of oil tank, due to not being securely fastened; 1 injured.

* November 1, 1919, locomotive 1508, Menominee, Mich. Shaker bar slipped from lever, due to being worn; 1 injured.

- * November 1, 1919, locomotive 2023, Ironwood, Mich. Piece broke off foot-board, causing brakeman to fall; 1 injured.
- ** December 11, 1919, locomotive 377, Hazel, Mich. Flue broke at weld due to crystallization of metal; 1 injured.
- December 15, 1919, locomotive 1019, near Gordon, Nebr. Headlight turbine steam pipe broke off at fountain connection in cab; 1 injured.
- ** January 2, 1920, locomotive 2322, Low Moor, Iowa. Bolt came out of cab apron, causing apron to drop down, permitting fireman to fall between locomotive and tender; 1 injured.
- ** January 20, 1920, locomotive 1419, near Oshawa, Minn. Reverse lever flew out of quadrant, due to latch spring broken or missing; 1 injured.
- January 27, 1920, locomotive 2017, Cedar Rapids, Iowa. Shaker bar broke; 1 injured.
- January 30, 1920, locomotive 2375, Nelson, Ill. Scalded by hot water from blow-off cock; blow-off cock operating lever would not lock, due to latch being bent; 1 injured.
- ** February 6, 1920, locomotive 2416, Chicago, Ill. Nuts missing from bolts securing front of step to bracket between left side of cab and engine deck, causing fireman to fall; 1 injured.
- ** February 11, 1920, locomotive 2608, Chicago, Ill. Injured while operating shaker bar; 1 injured.
- February 14, 1920, locomotive 1092, Carbondale, Mich. Flue broke at weld, due to crystallization of metal; 2 injured.
- February 16, 1920, locomotive 578, Fond du Lac, Wis. Injured due to broken hinge on tool-box door; 1 injured.
- February 28, 1920, locomotive 1617, near Madison, Wis. Crown sheet failure; low water; top water glass cock nearly closed at time of accident and opening in bottom water glass cock reduced to three thirty-seconds inch by scale formation; 1 injured.
- February 28, 1920, locomotive 9 (P. R. C. & N. W.), Summit Lake, Wis. Whistle-valve cap blew off; threads on cap badly worn and cap applied cross-threaded; 1 injured.
- March 12, 1920, locomotive 2419, Milwaukee, Wis. Grate-shaker rigging became disconnected; pin missing; 1 injured.
- ** March 17, 1920, locomotive 196, Fond du Lac, Wis. Injured while operating shaker bar, due to bolt coming out; 1 injured.
- March 18, 1920, locomotive 2009, Des Moines, Iowa. Footboard broke, causing switchman to fall; 1 injured.
- ** March 19, 1920, locomotive 1796, near Wilcox, Mich. Flue broke at weld; 1 injured.
- March 21, 1920, locomotive 175, near Powers, Mich. Flue broke at weld; 2 injured.
- March 26, 1920, locomotive 1084, near Huron, S. Dak. Water glass burst; cut by flying glass; inefficient shield; 1 injured.
- March 27, 1920, locomotive 2491, Burnett, Wis. Shaker bar slipped off post, due to improper fit; 1 injured.
- April 9, 1920, locomotive 1762, Milwaukee, Wis. Injured while operating throttle lever; insufficient clearance between lever and gauge cock; throttle very hard to close; 1 injured.
- April 12, 1920, locomotive 893, Green Bay, Wis. Cab apron became disconnected, due to bolts and rivets in hinges shearing off; 1 injured.
- April 19, 1920, locomotive 715, near Huron, S. Dak. Injured while operating shaker bar; connecting pin not properly secured, permitting connecting bolt to work out; 1 injured.
- April 30, 1920, locomotive 2340, Ironwood, Mich. Main fountain valve bonnet blew out, due to loose fit; 1 injured.
- May 10, 1920, locomotive 961, Casper, Wyo. Washout plug blew out; plug insecurely applied; 1 injured.
- May 11, 1920, locomotive 1119, Inman, Nebr. Safety device for holding blow-off cock closed missing; blow-off cock accidentally opened, scalding fireman; 1 injured.
- May 14, 1920, locomotive 2412, near Nelson, Ill. Top and cushion of seat box came off; screws missing from hinge; 1 injured.
- May 18, 1920, locomotive 445, Bordeaux, Nebr. Top bolt lost out of left back-up eccentric strap, permitting strap to come off, breaking link and causing reverse lever to become disengaged; 1 injured.

- ** May 19, 1920, locomotive 1377, Eagle Grove, Iowa. Handhold on tender broke; old fracture in handhold; 1 injured.
- June 7, 1920, locomotive 357, Sheboygan, Wis. Grate-shaker rigging became disconnected, due to bolt missing; 1 injured.
- June 29, 1920, locomotive 1420, Glenrock, Wyo. Defective shoveling sheet and apron; 1 injured.
- June 29, 1920, locomotive 2083, Chicago, Ill. Fuse plug burned out, and due to storeroom being out of these plugs the globe was broken from a small electric light and the base substituted for fuse plug; engineer cut hand on edges of glass; 1 injured.
- Forty-three accidents; 1 killed, 44 injured.
- CHICAGO, BURLINGTON & QUINCY RAILROAD:
- * August 10, 1919, locomotive 2123, Bay City, Wis. Squirt hose became disconnected; 1 injured.
- August 19, 1919, locomotive 2033, St. Louis, Mo. Squirt hose burst; defective hose; 1 injured.
- September 25, 1919, locomotive 2524, Brookfield, Mo. Washout plug blew out; attempted to tighten under pressure; defective threads in sheet and plug applied cross threaded; shoulder of graphite on plug and accumulation of graphite on sheet; 2 injured.
- December 9, 1919, locomotive 2195, Franklin, Nebr. Water glass burst, breaking shield glasses; cut by flying glass; 1 injured.
- December 9, 1919, locomotive 5355, Cameron Junction, Mo. Steam pipe to lower reverse gear cylinder burst; 1 injured.
- January 12, 1920, locomotive 5237, near Danville, Iowa. Crown-sheet failure; low water; no contributory causes found; side sheet, autogenously welded to crown sheet 11 inches below highest part of crown sheet, failed entire length; killed, 1 injured.
- * January 23, 1920, locomotive 2201, Brookfield, Mo. Water glass and shield burst; cut by flying glass; 1 injured.
- * February 24, 1920, locomotive 6125, Beardstown, Ill. Drawbar pulled from tender; 1 injured.
- * February 25, 1920, locomotive 6137, Smithboro, Ill. Main driving strap broke; 1 injured.
- * March 13, 1920, locomotive 1153, Braddyville, Iowa. Injured while shaking grates, due to shaker bar breaking; 1 injured.
- ** March 22, 1920, locomotive 1920, St. Joseph, Mo. Water glass burst; cut by flying glass; shield removed at time of accident; 1 injured.
- April 4, 1920, locomotive 1423, Lincoln, Nebr. Air pump steam pipe blew off at union-nut connection to throttle valve; threads on valve and on union nut badly worn; 1 injured.
- May 5, 1920, locomotive 1405, Lincoln, Nebr. Cylinder head blew out; accumulation of water in cylinders, due to bad leak at joint where standpipe connects to dry pipe; 1 injured.
- ** May 15, 1920, locomotive 1552, Lincoln, Nebr. Washout plug blew out; plug applied cross threaded; attempted to tighten under pressure; 1 injured.
- June 1, 1920, locomotive 2936, near Kansas City, Mo. Injector steam pipe brazing collar broke; sleeve of insufficient strength and improperly brazed; 1 injured.
- June 9, 1920, locomotive 950, Old Monroe, Mo. Blow-off cock extension failed at ell; threads on ell badly worn; 1 injured.
- June 20, 1920, locomotive 2198, near Laclede, Mo. Flue broke at weld; overheated in welding; 1 injured.
- Seventeen accidents; 2 killed, 18 injured.
- CHICAGO GREAT WESTERN RAILROAD:
- August 4, 1919, locomotive 269, near Thornton, Iowa. Arch tube pulled out of flue sheet, due to not being belled or beaded; examination disclosed that tube extended into sheet only $\frac{1}{8}$ inch at bottom and flush with sheet at top; 1 killed.
- * January 20, 1920, locomotive 452, Mason City, Iowa. Blow-off pipe came loose, escaping steam striking engineer; 1 injured.
- ** June 13, 1920, locomotive 314, St. Paul, Minn. Squirt hose burst; hose worn; 1 injured.
- Three accidents; 1 killed, 2 injured.

CHICAGO, MILWAUKEE & ST. PAUL RAILROAD:

July 2, 1919, locomotive 373, Milwaukee, Wis. Lubricator glass burst; 1 injured.

July 10, 1919, locomotive 2076, Dubuque, Iowa. Injector ram packing nut blew off; defective threads on packing nut and stuffing box; packing nut showed evidence of having been previously tightened by hammer and chisel; 1 injured.

July 15, 1919, locomotive 1259, Miles City, Mont. Boiler check stuck open; scalded by hot water from fire-hose connection, due to hose blowing off while attempting to seat check; 1 injured.

September 2, 1919, locomotive 8110, Beloit, Wis. Shaker bar slipped off lever; due to improper fit of bar on lever; 1 injured.

September 17, 1919, locomotive 8056, near Ipswich, S. Dak. Superheater tube broke; tube reduced in thickness at time of welding; 1 injured.

September 28, 1919, locomotive 5644, Minneapolis, Minn. Cylinder head blew out, due to engine working water; 1 injured.

October 4, 1919, locomotive 8170, Burgoyne, Mont. Shaker bar slipped off lever, due to broken socket; 1 injured.

October 7, 1919, locomotive 515, Milwaukee, Wis. Rivet at front end of step on smoke arch broke, allowing step to tilt, causing employee to fall; 1 injured.

October 24, 1919, locomotive 2443, Horicon, Wis. Arch tube pulled out of flue sheet; tube not of sufficient length to permit proper beading; 2 injured.

October 27, 1919, locomotive 1530, Sioux City, Iowa. Spring hanger broke, permitting locomotive to drop down and footboard to catch on rail and double back, resulting in fatal injury to switchman who was riding on footboard. Material in spring hanger crystallized; 1 killed.

November 1, 1919, locomotive 1196, Milwaukee, Wis. Water glass burst; cut by flying glass; inefficient shield; 1 injured.

November 13, 1919, locomotive 5048, Melstone, Mont. Hand rail not properly secured, permitting engineer to fall. Work reports for November 7 and 9 reported hand rail loose, and reports approved showing work performed; however, post at one end of hand rail was missing at time of accident; 1 injured.

December 6, 1919, locomotive 8083, O'Connors Siding, Minn. Crown sheet failure; low water; bottom of water glass obstructed by gasket; 1 injured.

December 24, 1919, locomotive 9511, Bensenville, Ill. Washout plug blew out of front flue sheet; threads on plug badly worn and corroded, and plug cross-threaded; 2 injured.

December 29, 1919, locomotive 3502, Elgin, Ill. Air pump bracket stud blew out; threads on stud wasted away, and stud entered $\frac{1}{4}$ inch sheet only $\frac{3}{8}$ inch; 1 injured.

January 5, 1920, locomotive 7038, Savanna, Ill. Rear end sill of tender crushed while pushing cut of cars; sill of weak construction; short grained fir wood used for sill, without reinforcing plate between coupler pad and end sill; 1 injured.

* January 29, 1920, locomotive 2202, Marmarth, N. Dak. Injured while operating reverse lever; lever would not clear injector handle; 1 injured.

February 1, 1920, locomotive 5529, near Calabar, Mont. Shaker bar slipped off lever, due to improper fit; 1 injured.

* February 21, 1920, locomotive 3505, Watertown, Wis. Injured due to loose running board over air drum; 1 injured.

February 23, 1920, locomotive 1149, Dubuque, Iowa. Piston rod broke, knocking out cylinder head; old flaw in rod; 2 injured.

March 7, 1920, locomotive 6722, near Thunder Hawk, S. Dak. Crown sheet failure, due to heavy fillets of scale around heads of radial stays; threads on stays and in crown sheet badly deteriorated; 1 injured.

March 15, 1920, locomotive 9600, Corfu, Wash. Injured while operating reverse lever; stop pins missing from reverse lever quadrant; 1 injured.

March 18, 1920, locomotive 6530, Ottumwa, Iowa. Washout plug blew out; plug insecurely applied; 1 injured.

March 28, 1920, locomotive 8623 (U. S.), near Techy, Ill. Crown sheet failure; low water; left water glass broken, and top and bottom cocks closed; right water glass too short, and practically closed at bottom end by gasket; autogenously welded seam, joining combustion chamber crown sheet to crown sheet proper, failed for a distance of 35 inches; 2 killed, 1 injured.

* April 2, 1920, locomotive 2146, Port Townsend, Wash. Packing nut blew off of injector; 1 injured.

May 18, 1920, locomotive 2083, Marion, Iowa. Right injector steam pipe nut

** June 5, 1920, locomotive 2148, Regent, N. Dak. Injured while operating reverse lever, due to counterbalance spring having lost out; 1 injured.

June 9, 1920, locomotive 6336, Bagley, Iowa. Superheater tube broke at weld; overheated in welding; 2 injured.

** June 15, 1920, locomotive 5517, near Bucyrus, N. Dak. Reverse lever flew out of quadrant, due to reach rod not properly secured; 1 injured.

June 16, 1920, locomotive 2758, near Warner, S. Dak. Driving axle broke; old defect in axle; 1 injured.

Thirty accidents; 3 killed, 33 injured.

CHICAGO, ROCK ISLAND & PACIFIC RAILROAD:

* July 6, 1919, locomotive 488, Alexandria, La. Handle of blow-off cock broke; injured.

** July 18, 1919, locomotive 2107, Alvord, Mo. Air pipe to fire-door air cylinder broke at collar; 1 injured.

July 20, 1919, locomotive 956, Lavant, Kans. Screw reverse gear latch became disengaged; latch worn and spring inoperative; 1 injured.

* July 31, 1919, locomotive 251, Biddle, Ark. Squirt hose burst; 1 injured.

* August 8, 1919, locomotive 1608, Blue Island, Ill. Cylinder head blew out; injured.

* August 17, 1919, locomotive 614, Ingersoll, Okla. Injured while operating reverse lever, due to counterbalance rod breaking; 1 injured.

August 25, 1919, locomotive 2535, near McFarland, Kans. Failure of autogenous welds on frames of Vanderbilt type tender; 1 injured.

August 28, 1919, locomotive 2134, Bowen, Mo. Crank pin collar nut worked loose, permitting knuckle joint pin to strike main rod and right front rod to strike rocker arm, reversing engine; 1 injured.

September 12, 1919, locomotive 420, Hebron, Nebr. Whistle blew out while attempting to tighten; whistle applied cross threaded; work report on file for September 3 bears the following notation, "Whistle leaks where it screws to pipe; work was not done as engine was under steam"; 1 injured.

November 13, 1919, locomotive 644, Salina, Kans. Blow-off cock operating rod missing, and rope which was attached to blow-off cock broke, while attempting to operate blow-off cock; 1 injured.

November 21, 1919, locomotive 2584, Kansas City, Kans. Front end door hinges broke, allowing door to fall and strike employee; old crack in top hinge; hinges not of sufficient strength; 1 injured.

December 5, 1919, locomotive 1502, Topeka, Kans. Headlight turbine broke; glass case which incloses graphite ring worn in two; 1 killed.

December 11, 1919, locomotive 1294, Herrington, Kans. Injured while operating grate shaker, due to cotter key missing; 1 injured.

December 11, 1919, locomotive 1965, (C. R. I. & G.), Pratt, Kans. Crown sheet failure; low water; no contributory causes found; right side sheet crown sheet welded seam failed, and right side sheet door sheet welded seam failed; injured.

December 13, 1919, locomotive 1998, Renfrow, Okla. Flue broke at safe end; overheated in welding; 2 injured.

* December 23, 1919, locomotive 1420, Bucklin, Kans. Injured due to fire door swinging shut, caused by latch on wind sheet that holds door open being tight; 1 injured.

December 25, 1919, locomotive 1472, Goldfield, Iowa. Lubricator oil glass blew out, due to improper workmanship; cap calked with peen of a hammer; 1 injured.

December 25, 1919, locomotive 234, Blue Island, Ill. Bolt worked out of throttle lever latch, preventing throttle from being closed, causing locomotive to collide with caboose, while engaged in switching service; 1 injured.

January 17, 1920, locomotive 1009, Clear Lake Junction, Iowa. Staybolt blew out of firebox side sheet. This bolt had been applied without ever having been threaded on the outer end; due to constant leaking each end of the bolt had been riveted and peened until the threads were stripped on firebox end, when it blew out seriously burning the fireman. Work reports, as required

Rule 104, contained numerous notations since November 28: "Bad leak under jacket right side ahead of cab." These reports had been approved, indicating that proper repairs had been made in each instance; 1 injured.

February 2, 1920, locomotive 1163, Elmira, Iowa. Flue broke; overheated in welding; 1 injured.

February 10, 1920, locomotive 1875, near Tinsman, Ark. Two-inch plug blew out of crown sheet; plug not secured with staybolt or stay rod, and threads on plug and in sheet practically wasted away; 2 injured.

**February 16, 1920, locomotive 1853, Calion, Ark. Injured while operating shaker bar, due to grate connection rod burning in two; 1 injured.

March 13, 1920, locomotive 2021, near Marseilles, Ill. Left crosshead connection link broke, due to old flaw, rendering valve gear inoperative, trapping steam in left cylinder, knocking out left front cylinder head and damaging driving gear; 1 injured.

March 30, 1920, locomotive 2506, Linwood, Kans. Injured while shaking grates due to shaker rod failing; 1 injured.

May 3, 1920, locomotive 2117, Seminole, Okla. Grease plug blew out back end of left main rod while attempting to remove; defective threads in bushing and on plug; 1 injured.

May 12, 1920, locomotive 2132, Seminole, Okla. Fire door casting stud blew out of boiler; stud only screwed into boiler $\frac{3}{4}$ " ; 2 injured.

May 29, 1920, locomotive 246, Burr Oak, Ill. Injured while shaking grates, due to pin breaking; old flaw in pin; 1 injured.

June 9, 1920, locomotive 883, near Perry, Kans. Reverse lever became unlatched while running at a speed of about 50 miles per hour; 1 injured.

June 13, 1920, locomotive 2550, near Paxico, Kans. Crown sheet failure; low water; no contributory causes found; 2 killed, 1 injured.

Twenty-nine accidents; 3 killed, 35 injured.

CHICAGO, ST. PAUL, MINNEAPOLIS & OMAHA RAILROAD:

December 7, 1919, locomotive 28, St. Paul, Minn. Shaker bar broke; old flaw in bar at point of failure; 1 injured.

**February 28, 1920, locomotive 51, Minneapolis, Minn. Ventilator in cab roof came loose, falling through opening and striking fireman; ventilator insecurely fastened; 1 injured.

**February 28, 1920, locomotive 153, St. Paul, Minn. Foot board broke, causing switchman to fall; 1 injured.

March 14, 1920, locomotive 354, near Sheldon, Iowa. Crown sheet failure; low water; bottom water glass cock partially closed by scale formation; hole for bottom water glass fitting tapped directly in line with back head brace, and fitting extended to within $\frac{1}{4}$ " of brace; 1 injured.

March 29, 1920, locomotive 76, Altoona, Wis. Injured while attempting to shake grates; grates inoperative; 1 injured.

**March 31, 1920, locomotive 48, Minneapolis, Minn. Shaker bar slipped off post; grate rod goes too far back when dump grate is open; 1 injured.

Six accidents; 6 injured.

CINCINNATI, INDIANAPOLIS & WESTERN RAILROAD:

*January 17, 1920, locomotive 151, Hillsdale, Ind. Injured while shaking grates, due to rod becoming disconnected; 1 injured.

One accident; 1 injured.

CINCINNATI NORTHERN RAILROAD:

July 11, 1919, locomotive 5565, Van Wert, Ohio. Arch tube plug blew out of throat sheet; attempted to tighten under pressure; plug cross-thread; 1 injured.

October 2, 1919, locomotive 6382, Van Wert, Ohio. Arch tube plug blew out of throat sheet; attempted to tighten under pressure; defective threads in hole and plug not securely tightened; 2 injured.

Two accidents; 3 injured.

CLEVELAND, CINCINNATI, CHICAGO & ST. LOUIS RAILWAY:

*October 15, 1919, locomotive 6280, Vienna, Ill. Reverse lever slipped out of quadrant, due to weak spring; 1 injured.

November 9, 1919, locomotive 7364, Cleveland, Ohio. Lubricator filling plug blew out; defective threads in lubricator, and plug too small to properly engage threads in lubricator body; 1 injured.

Two accidents; 2 injured.

COLORADO & SOUTHERN RAILROAD:

* July 13, 1919, locomotive 606, Rivera, Colo. Injector spanner nut blew off, due to defective threads; 1 injured.

* September 19, 1919, locomotive 646, near Silver Crown, Wyo. Squirt hose blew off; 1 injured.

October 9, 1919, locomotive 632, Trinidad, Colo. Water glass burst; cut by flying glass; 1 injured.

Three accidents; 3 injured.

DELAWARE & HUDSON RAILROAD:

* November 6, 1919, locomotive 811, East Worcester, N. Y. Ash-pan lever slipped off lug, due to being worn; 1 injured.

January 3, 1920, locomotive 847, Carbondale, Pa. Outside corner of foot-board broke off, permitting injured party to fall; 1 injured.

March 29, 1920, locomotive 547, near Port Henry, N. Y. Injured while opening ash-pan slides, due to casting holding ash-pan post at mud ring breaking; 1 injured.

April 2, 1920, locomotive 1018, Starrucca, Pa. Superheater unit broke at return bend; metal reduced in thickness at time threads were cut on unit pipes at return bend connection; 1 injured.

April 9, 1920, locomotive 737, Carbondale, Pa. Lubricator filling glass and backing nut blew out; threads in lubricator distorted; 1 injured.

May 5, 1920, locomotive 1605, Herrick Center, Pa. Flue broke at weld; overheated in welding; 1 injured.

May 19, 1920, locomotive 748, Nineveh, N. Y. Washout plug blew out; plug not securely applied; 1 injured.

June 30, 1920, locomotive 804, Oneonta, N. Y. Washout plug blew out; plug not securely applied; 1 injured.

Eight accidents; 8 injured.

DELAWARE, LACKAWANNA & WESTERN RAILROAD:

July 30, 1919, locomotive 506, Oxford, N. Y. Scalded by hot water from injector delivery pipe spanner nut; threads on spanner nut stripped, due to use of hammer and chisel in tightening; 1 injured.

August 20, 1919, locomotive 1034, Hunlocks Creek, Pa. Main rod broke; old defect at point of failure 35 per cent the cross-sectional area of rod; 1 injured.

January 17, 1920, locomotive 1128, near Horseheads, N. Y. Crown sheet failure; low water; no contributory causes found; 1 killed, 1 injured.

Three accidents; 1 killed, 3 injured.

DENVER & RIO GRANDE RAILROAD:

* August 28, 1919, locomotive 206, Embudo, N. Mex. Valve handle of water glass screwed out, due to valve of improper design; 1 injured.

October 13, 1919, locomotive 705, Salt Lake City, Utah. Lubricator throttle broke off at reducer fitting connection while locomotive was under hydrostatic pressure; 1 injured.

December 27, 1919, locomotive 701, near Paonia, Colo. Shaker bar slipped off lever, due to being insecurely fastened; 1 injured.

January 2, 1920, locomotive 916, Sierra, Colo. Water glass burst; cut by flying glass; defective wire mesh shield; 1 injured.

* January 5, 1920, locomotive 649, Salt Lake City, Utah. Footboard on locomotive broke; 1 injured.

January 13, 1920, locomotive 759, Salida, Colo. Main driving wheel axle broke at both ends, due to old flaw in axle; 1 injured.

Six accidents; 6 injured.

DETROIT & MACKINAC RAILWAY:

** May 25, 1920, locomotive 3, near Emery Junction, Mich. Side rod broke; rod showed indications of crystallization and small fracture at point of failure; 1 injured.

One accident; 1 injured.

DETROIT & TOLEDO SHORE LINE RAILROAD:

* March 24, 1920, locomotive 102, Lang, Ohio. Nozzle on fire hose blew off, scalding brakeman; 1 injured.

One accident; 1 injured.

DETROIT, TOLEDO & IRONTON RAILROAD:

* December 31, 1919, locomotive 101, Lima, Ohio. Shaker bar became disconnected, due to pin dropping out of connection; 1 injured.

DULUTH, MISSABE & NORTHERN RAILWAY:

*July 19, 1919, locomotive 502, Turney, Minn. Grate connection broke while fireman was shaking grates; 1 injured.

** October 31, 1919, locomotive 303, Mitchell, Minn. Flue broke; 1 injured.
Two accidents; 2 injured.

DULUTH, WINNIPEG & PACIFIC RAILWAY:

December 26, 1919, locomotive 2457, Bartlett, Minn. Crown sheet failure; low water; no contributory causes found; 3 injured.
One accident; 3 injured.

ERIE RAILROAD:

July 5, 1919, locomotive 1628, Midvale, N. J. Lubricator glass and packing nut blew out; nut applied cross threaded, and threads in body of lubricator stripped; 1 injured.

** July 7, 1919, locomotive 513, Jersey City, N. J. Squirt hose blew off; hose not clamped; 1 injured.

July 8, 1919, locomotive 3083, Avoca, Pa. Washout cap blew off; attempted to tighten under pressure; old defect in cap; 2 injured.

August 14, 1919, locomotive 3054, Campbell Hall, N. Y. Injector steam pipe pulled out of collar at starting valve connection; collar not properly brazed on injector steam pipe; 3 injured.

October 6, 1919, locomotive 1778, Chicago, Ill. Crown sheet failure; low water; gauge cock drip partially stopped up; 1 injured.

January 9, 1920, locomotive 2026, near Griffith, Ind. Inside leg of spring saddle broke, permitting locomotive to drop down in front; old fracture in spring saddle; 1 injured.

January 9, 1920, locomotive 830, Jersey City, N. J. Lubricator glass and packing nut blew out; threads on nut stripped; 1 injured.

January 14, 1920, locomotive 533, Lancaster, N. Y. Flue broke at weld; overheated in welding; flue badly deteriorated; 1 injured.

January 22, 1920, locomotive 2567, Hornell, N. Y. Air compressor oil cup broke off, due to old flaw; 1 injured.

January 31, 1920, locomotive 1723, Ohio City, Ohio. Main rod broke, due to old flaw, knocking out cylinder head; 1 injured.

February 15, 1920, locomotive 2028, Hornell, N. Y. Blower valve bonnet blew out, due to loose fit; 1 injured.

February 22, 1920, locomotive 2544, Cochection, N. Y. Drawbar pinhole in engine deck casting broke entirely out, allowing drawbar pin to pull out; both safety chains failed at clevis connection to deck plate; wings supporting drawbar pinhole boss reduced from their original thickness of $\frac{1}{2}$ " to $\frac{1}{8}$ ", due to deterioration or wasting away; 1 injured.

April 27, 1920, locomotive 1597, Clarion Junction, Pa. Petticoat pipe became loose and dropped from its proper position, causing back draft, due to being improperly and insecurely fastened; 1 injured.

May 5, 1920, locomotive 3024, Coalberg Junction, N. J. Flue broke at weld; overheated in welding; 2 injured.

Fourteen accidents; 18 injured.

FLORIDA EAST COAST RAILWAY:

** December 27, 1919, locomotive 96, near New Smyrna, Fla. Air pump steam pipe collar nut broke; 1 injured.

January 13, 1920, locomotive 76, Jacksonville, Fla. Spring hanger broke, permitting locomotive to drop sufficiently to cause footboard to catch on crossing planks; old defect in hanger; 1 injured.

Two accidents; 2 injured.

FORT WORTH & DENVER CITY RAILWAY:

January 16, 1920, locomotive 611 (C. & S.), near Goodlett, Tex. Crown sheet failure; low water; water foaming; left injector inoperative; 3 injured.

*February 15, 1920, locomotive 802, Wichita Falls, Tex. Water glass burst; cut by flying glass; 1 injured.

Two accidents; 4 injured.

GEORGIA SOUTHERN & FLORIDA RAILWAY:

October 25, 1919, locomotive 162, Valdosta, Ga. Blow-off cock discharge pipe was applied so as to form a trap for the accumulation of hot water, which

January 14, 1920, locomotive 139, Howell, Ga. Squirt hose blew off; hose defective, and insecurely clamped; 1 injured.
Two accidents; 2 injured.

GRAND TRUNK RAILWAY:

*February 11, 1920, locomotive 513, Island Pond, Vt. Bonnet to main steam valve worked loose and blew out; 1 injured.
One accident; 1 injured.

GREAT NORTHERN RAILWAY:

July 13, 1919, locomotive 1484, near Telstad, Mont. Crown sheet failure; low water; top opening of water glass closed by rubber gasket, due to glass being too short; tank valve disconnected and strainer partially closed with weeds, seriously reducing the capacity of injector; 3 killed, 1 injured.

*July 30, 1919, locomotive 1918, Cascade Tunnel, Wash. Squirt hose burst; 1 injured.

*August 13, 1919, locomotive 1172, Chattaroy, Wash. Packing blew out of steam grate shaker; 1 injured.

*August 23, 1919, locomotive 387, Clearwater Junction, Minn. Scalded while using squirt hose; hose split; 1 injured.

September 21, 1919, locomotive 1418, St. Paul, Minn. Washout plug blew out, due to being insecurely applied; defective threads on plug; 1 injured.

*October 1, 1919, locomotive 1910, Leavenworth, Wash. Water glass and shield broke; cut by flying glass; 1 injured.

*October 5, 1919, locomotive 704, Wenatchee, Wash. Cab apron dropped between locomotive and tender; apron defective; 1 injured.

*October 8, 1919, locomotive 3028, Elmira, Wash. Injured while operating reverse lever, due to weak counter-balance spring; 1 injured.

October 21, 1919, locomotive 1138, near Kremlin, Mont. Shaker bar slipped off lever; 1 injured.

**November 7, 1919, locomotive 1517, Breckenridge, Minn. Water glass burst; cut by flying glass; defective shield; 1 injured.

November 10, 1919, locomotive 1141, Kremlin, Mont. Squirt hose pipe broke while attempting to tighten; 1 injured.

*November 11, 1919, locomotive 1964, Fielding, Mont. Superheater tube burst; 1 injured.

**November 15, 1919, locomotive 1169, Hixon, Minn. Lubricator glass burst; inefficient shield; burned by escaping hot oil; 1 injured.

November 17, 1919, locomotive 3071, Havre, Mont. Shaker bar broke; old fracture in bar; 1 injured.

**November 23, 1919, locomotive 607, near Merrill, Iowa. Injector steam pipe pulled out of collar, due to defective brazing; 1 injured.

**December 24, 1919, locomotive 211, near Zena, Wash. Right side rod broke; old flaw in rod; 2 injured.

*December 31, 1919, locomotive 843, Superior, Wis. Water glass burst; cut by flying glass; 1 injured.

**February 13, 1920, locomotive 1057, St. Paul, Minn. Water glass burst; cut by flying glass, inefficient shield; 1 injured.

*March 9, 1920, locomotive 1323, Stryket, Mont. Injured while shaking grates, due to pin coming out of shaker post; 1 injured.

March 11, 1920, locomotive 227, near Hinckley, Minn. Right side rod broke, due to crystallization of metal in rod; 2 injured.

*March 26, 1920, locomotive 2007, Summit, Mont. Grab iron pulled off of locomotive, causing conductor to fall; 1 injured.

*April 15, 1920, locomotive 900, Havre, Mont. Squirt hose blew off pipe connection; 1 injured.

**April 17, 1920, locomotive 359, Forestville, S. Dak. Injured while using ashpan swipe; joint at valve became disconnected; rod not securely attached to valve; 1 injured.

April 30, 1920, locomotive 728, Downer Pit, Minn. Water glass burst; inefficient shield; cut by flying glass; 1 injured.

May 9, 1920, locomotive 961, Crookston, Minn. Spanner nut of right boiler check pulled off; threads in spanner nut badly worn and deteriorated; 1 injured.

June 25, 1920, locomotive 1420, Cato, Mont. Air hose between engine and tender blew off; defective hose; 1 injured.

Twenty-six accidents; 3 killed, 28 injured.

GULF COAST LINES.

*July 22, 1919, locomotive 55, DeQuincy, La. Squirt hose blew off; hose not clamped; 1 injured.

February 29, 1920, locomotive 43 (N. I. & N.), Harlingen, Tex. Crown sheet failure; low water; threads on 26 radial stays in center of crown sheet and threads in radial stay holes deteriorated; 1 killed.

Two accidents; 1 killed, 1 injured.

HOCKING VALLEY RAILWAY:

*December 26, 1919, locomotives 167-176, Carroll, Ohio. Locomotives separated, due to failure of drawbar; 1 injured.

One accident; 1 injured.

ILLINOIS CENTRAL RAILROAD:

July 3, 1919, locomotive 1103, near Love, Miss. Air pump throttle broke off at fountain; air-pump pipe resting on cab, causing vibration of pipe; 1 injured.

*July 10, 1919, locomotive 1416, Chicago, Ill. Shaker lever broke while shaking grates; 1 injured.

August 2, 1919, locomotive 982, Cynthia, Miss. Squirt hose blew off; hose insecurely clamped; 1 injured.

October 17, 1919, locomotive 919, Teague, Tenn. Squirt hose burst; defective hose; 1 injured.

January 10, 1920, locomotive 217, Memphis, Tenn. Drawbar and safety chains broke, permitting locomotive and tender to separate; metal crystalized; 1 killed.

March 29, 1920, locomotive 1059, near Durant, Miss. Injector steam pipe collar broke; defective sleeve; 2 injured.

May 20, 1920, locomotive 2305, Memphis, Tenn. Washout plug blew out; attempted to tighten under pressure; plug cross-threaded; 1 injured.

*June 14, 1920, locomotive 1050, Belleflower, Ill. Scalded by hot water, due to squirt hose bursting; 1 injured.

Eight accidents; 1 killed, 8 injured.

INDIANA HARBOR BELT RAILROAD:

February 16, 1920, locomotive 5423, Franklin Park, Ill. Dynamo throttle bonnet blew out; defective threads on bonnet, and loose fit; 1 injured.

June 9, 1920, locomotive 152, Hessville, Ind. Handle came off spindle of blow-off cock; nut missing from spindle; 1 injured.

Two accidents; 2 injured.

INTERNATIONAL & GREAT NORTHERN RAILWAY:

August 16, 1919, locomotive 245, Trinity, Tex. Squirt hose parted at splice; hose not clamped; 1 injured.

December 24, 1919, locomotive 231, Palestine, Tex. Crown sheet failure; low water; no contributory causes found; 2 injured.

May 7, 1920, locomotive 142, San Antonio, Tex. Water glass burst; cut by flying glass; 1 injured.

Three accidents; 4 injured.

KANSAS CITY, MEXICO & ORIENT RAILWAY:

*July 7, 1919, locomotive 501, near Bronte, Tex. Flue broke; 1 injured.

*October 15, 1919, locomotive 210, Runnymede, Kans. Squirt hose blew off; 1 injured.

Two accidents; 2 injured.

KANSAS CITY SOUTHERN RAILWAY:

*October 9, 1919, locomotive 707, Asbury, Mo. Injector branch pipe became disconnected; 1 injured.

*February 9, 1920, locomotive 800, Cleveland, Mo. Squirt hose bushing failed at injector feed pipe connection; defective threads on bushing; 1 injured.

*February 11, 1920, locomotive 466, Sugar Creek, Mo. Steam end of turbo generator to headlight burst; 2 injured.

**May 2, 1920, locomotive 89, Shreveport, La. Squirt hose burst; defective hose; 1 injured.

Four accidents; 5 injured.

LEHIGH & NEW ENGLAND RAILROAD:

**October 3, 1919, locomotive 152, Lansford, Pa. Stud holding throat stay blew out of bottom of inner throat sheet in fire box; threads on bolt practically corroded away, and throat sheet badly pitted and corroded; original thickness of sheet, three eighths inch; thickness at time of accident, three-sixteenths inch; 1 injured.

One accident; 1 injured.

LEHIGH VALLEY RAILROAD:

*December 30, 1919, locomotive 2132, P. & L. Junction, N. Y. Drifting valve blew out; 1 injured.

*January 5, 1920, locomotive 1648, Mauch Chunk, Pa. Hand caught between reverse lever and boiler head, due to insufficient clearance; 1 injured.

**May 12, 1920, locomotive 2021, Sayre, Pa. Injector steam pipe broke off at collar; 1 injured.

Three accidents; 3 injured.

LONG ISLAND RAILROAD:

*September 24, 1919, locomotive 213, Kings Park, N. Y. Injector steam pipe collar broke; 1 injured.

One accident; 1 injured.

LOS ANGELES & SALT LAKE RAILROAD:

November 14, 1919, locomotive 3201, Salt Lake City, Utah. Transmission bar broke, causing reverse lever to fly out of quadrant; 1 injured.

One accident; 1 injured.

LOUISVILLE & NASHVILLE RAILROAD:

*July 18, 1919, locomotive 141, Deatsville, Ala. Injured while shaking grates, due to rod becoming disconnected, caused by cotter pin losing out; 1 injured.

July 26, 1919, locomotive 879, Randor, Tenn. Back end of running board, constituting cab floor, broke off, permitting fireman to fall; cab floor boards rotted off between cab door sill and cab bracket; 1 injured.

September 13, 1919, locomotive 1517, Springfield, Tenn. Shaker bar slipped off lever; 1 injured.

September 17, 1919, locomotive 1507 (U. S.), Hygeia Springs, Tenn. Crown sheet failure; low water; no contributory causes found; 1 killed, 1 injured.

**September 28, 1919, locomotive 621, Montgomery, Ala. Cab apron became disconnected, due to bolt working out; 1 injured.

October 10, 1919, locomotive 776 (N. C. & St. L.), Nashville, Tenn. Injured while shaking grates, due to cotter key working out of pin; 1 injured.

**November 24, 1919, locomotive 1209, Garland, Ala. Injured while operating ash-pan slides; ash pan difficult to operate, due to dirt accumulated in grooves; 1 injured.

November 25, 1919, locomotive 863, Georgiana, Ala. Injured while operating shaker bar, due to bridle bar to back section of grates being bent; 1 injured.

*December 14, 1919, locomotive 1230, Colesburg, Ky. Injured while making coupling, due to knuckle pin missing; 1 injured.

February 9, 1920, locomotive 284, Berlin, Ala. Crown sheet failure; low water; no contributory causes found; 1 injured.

**February 10, 1920, locomotive 1230, Tyson, Ala. Shaker bar became disconnected while fireman was operating grates; 1 injured.

**February 20, 1920, locomotive 430 (N. C. & St. L.), Mayton, Tenn. Charcoal tap welded seam arch tube failed in welded seam; 1 injured.

**February 29, 1920, locomotive 1077, La Grange, Ky. Pin lost out of ash-pan lever, causing lever to become disconnected; 1 injured.

**March 7, 1920, locomotive 132, Stanford, Ky. Globe valve bonnet packing leaking; 1 injured.

April 7, 1920, locomotive 1252, Verbena, Ala. Injured while shaking grates, due to reach rod breaking; old crack in rod; 1 injured.

**April 18, 1920, locomotive 1119, Bowling Green, Ky. Handhold on tank gave way; handhold insecurely attached; 1 injured.

April 26, 1920, locomotive 750, Rigolets, La. Blower valve bonnet blew off, due to nut securing bonnet to body of valve being loose; 1 injured.

May 7, 1920, locomotive 1072, Viper, Ky. Lubricator feed valve broke off while attempting to tighten packing nut; 1 injured.

June 9, 1920, locomotive 1317, Montgomery, Ala. Nut connecting three-way cock and blow-off cock came off, due to defective threads on nut; 1 injured.

June 10, 1920, locomotive 501, near Louisville, Ky. Shaker rigging became disconnected, due to cotter key missing; 1 injured.

** June 16, 1920, locomotive 1464, Livingston, Ky. Shaker bar slipped off, due to lever being broken; 1 injured.

Twenty-one accidents; 1 killed, 21 injured.

MACON & BIRMINGHAM RAILWAY:

November 24, 1919, locomotive 6, Skipperton, Ga. Crown sheet failure; low water; top water glass connection partially closed with asbestos packing; tank valves disconnected and out of place; right injector throttle valve on boiler head and globe valve on overflow pipe closed; crack at calking edge of left side sheet crown sheet seam full length of firebox, which had been autogenously welded; this seam failed the entire length; 1 killed, 1 injured.

One accident; 1 killed, 1 injured.

MAINE CENTRAL RAILROAD:

** July 17, 1919, locomotive 463, Freeport, Me. Injector steam pipe pulled off collar; pipe insecurely applied; 1 injured.

One accident; 1 injured.

MICHIGAN CENTRAL RAILROAD:

** September 28, 1919, locomotive 8931, Jackson Junction, Mich. Locomotive had been left on storage track, and engineer had reported "Take up about 3-inch slack in throttle lever." In making repairs, the throttle lever rod was shortened $1\frac{1}{4}$ inches, making it $\frac{1}{4}$ inch too short, which raised throttle valve about $\frac{3}{8}$ inch off seat, permitting locomotive to move ahead for a distance of about 700 feet and collide with steel box car; locomotive and car ran for a distance of $\frac{1}{4}$ of a mile, at a speed of 20 miles per hour, and collided with two sand cars; 1 injured.

* October 3, 1919, locomotive 8760, Joliet, Ill. Squirt hose blew off; 1 injured.

** November 14, 1919, locomotive 8754, Jackson, Mich. Shaker bar broke, due to old flaw; 1 injured.

** November 17, 1919, locomotive 8912, Jackson, Mich. Water glass burst; defective shield; scalded by escaping hot water; 1 injured.

December 16, 1919, locomotive 7728, Jackson, Mich. Cylinder head blew out; 1 injured.

January 15, 1920, locomotive 7891, Niles, Mich. Blow-off cock bonnet blew off, due to improper application; 1 injured.

January 23, 1920, locomotive 7921, Niles, Mich. Water scoop-heater hose blew off, scalding fireman; 1 injured.

** February 19, 1920, locomotive 7877, Detroit, Mich. Water glass burst; cut by flying glass; 1 injured.

May 26, 1920, locomotive 8455, near Bay City, Mich. Crown sheet failure; low water; top water glass cock found closed; autogenously welded seam of patch on crown sheet failed completely for $16\frac{1}{2}$ inches, and showed distress for the remaining $53\frac{1}{2}$ inches; 2 killed, 1 injured.

Nine accidents; 2 killed, 9 injured.

MIDLAND VALLEY RAILROAD:

January 6, 1920, locomotive 22, Lefeber, Okla. Crown sheet failure; low water; operating without water glass; 1 injured.

* April 9, 1920, locomotive 23, Lefeber, Okla. Flue burst; 1 injured.

Two accidents; 2 injured.

MINNEAPOLIS & ST. LOUIS RAILROAD:

* September 22, 1919, locomotive 473, Chaska, Minn. Drain cock blew out of reservoir; 1 injured.

* December 13, 1919, locomotive 406, Corwith, Iowa. Injured while operating reverse lever, due to pin coming out; 1 injured.

* February 27, 1920, locomotive 66, Oskaloosa, Iowa. Shaker bar broke, due to old defect; 1 injured.

March 23, 1920, locomotive 443, Peoria, Ill. Arch tube pulled out of flue sheet; tube did not extend through sheet far enough to permit of bellling or beading; 1 injured.

* May 28, 1920, locomotive 302, Eleanor, Ill. Squirt hose burst; 1 injured.

Five accidents; 5 injured.

MINNEAPOLIS, ST. PAUL & SAULT STE. MARIE RAILWAY:

September 26, 1919, locomotive 122, Onamia, Minn. Throttle flew open, due to lost motion; daily inspection report for September 24 contained needed repairs reported, "Main throttle disconnected and stuck open; take up slack in main throttle stem connection inside;" slack not repaired; 1 injured.

December 6, 1919, locomotive 473, near Wendal, Minn. Drawbar and safety chains failed, permitting locomotive and tender to separate; old fracture in drawbar and safety chains of too light construction; 1 injured.

* May 3, 1920, locomotive 428, Shoreham, Minn. Water glass broke; cut by flying glass; 1 injured.

* June 15, 1920, locomotive 2425, Burlington, Wis. Shaker bar broke; 1 injured.

Four accidents; 4 injured.

MINNESOTA, DAKOTA & WESTERN RAILWAY:

** January 17, 1920, locomotive 103, International Falls, Minn. Both back cylinder heads leaking; both valve stems blowing, and left steam chest leaking, obscuring vision of engineer, causing collision; 1 injured.

One accident; 1 injured.

MISSOURI, KANSAS & TEXAS RAILWAY:

July 3, 1919, locomotive 768, Smithville, Tex. Crown sheet failure; low water; no contributory causes found; 1 injured.

July 15, 1919, locomotive 671, Greenville, Tex. Crown sheet failure; low water; lower gauge cock only $2\frac{1}{2}$ inches above highest point of crown sheet; 2 injured.

* September 1, 1919, locomotive 29, Waco, Tex. Shaker bar slipped off post while fireman was shaking grates; 1 injured.

September 10, 1919, locomotive 715, near Mahan, Okla. Bonnet of coal passer valve blew off; holding nut on valve bonnet not properly tightened; 1 injured.

* September 15, 1919, locomotive 584, Cushing, Okla. Scalded by hot water from defective squirt hose; 1 injured.

October 7, 1919, locomotive 443, Junction City, Kans. Headlight turbine wheel broke; two spokes in wheel showed old fractures; governor defective; 1 injured.

November 28, 1919, locomotive 9, Denison, Tex. Crown sheet failure; low water; bottom of water glass partially closed by rubber gasket; top gauge cock stuck shut, and stopped up with sediment; gauge cock reported five times previous to accident and repairs not made; 1 killed, 2 injured.

* December 5, 1919, locomotive 248, Wichita Falls, Tex. Lubricator filling plug blew out; threads on plug stripped; 1 injured.

* January 5, 1920, locomotive 724, Denison, Tex. Main rod broke, knocking out cylinder head; 1 injured.

* January 10, 1920, locomotive 276, Hagerman, Tex. Handrail on locomotive became loose, striking passenger; 1 injured.

February 9, 1920, locomotive 371, near Pryor, Okla. Bolt worked out of front end of reverse lever quadrant, permitting lever to fly out of quadrant with sufficient force to knock bracket holding front end of quadrant off boiler head, pulling one stud out of boiler head; 1 injured.

February 10, 1920, locomotive 837, Bluffton, Mo. Crown sheet failure; low water; top water-glass cock found open only one-sixteenth of a turn; left injector ram handle broken; 2 injured.

* February 19, 1920, locomotive 368, Whitewright, Tex. Connecting rod to shaker bar broke; 1 injured.

* March 19, 1920, locomotive 363, New Franklin, Mo. Right piston rod broke just ahead of keyway, knocking out right front cylinder head; piston showed old defect about two-thirds of way through; 1 killed.

May 30, 1920, locomotive 363, Calhoun, Mo. Right front bottom gib bolt broke while running about 50 miles per hour, allowing crosshead arm to drop,

which caused front cylinder head to be blown off, causing instant death of station agent; 1 killed.

June 18, 1920, locomotive 520, Yale, Okla. Squirt hose parted at splice; hose improperly spliced; 1 injured.

Sixteen accidents; 3 killed, 17 injured.

MISSOURI PACIFIC RAILROAD:

July 1, 1919, locomotive 126, St. Louis, Mo. Squirt hose burst; defective hose; 1 injured.

July 7, 1919, locomotive 2709, Wynne, Ark. Injured while attempting to close blow-off cock, which had failed to seat, due to rivet lodging in valve; 1 injured.

July 11, 1919, locomotive 58, Gurdon, Ark. Insufficient clearance between shaker bar and throttle quadrant, allowing fireman's hand to be caught; 1 injured.

*August 4, 1919, locomotive 9444, Kansas City, Mo. Squirt hose burst; 1 injured.

August 8, 1919, locomotive 7518, Pine Bluff, Ark. Squirt hose burst; defective hose; 1 injured.

August 10, 1919, locomotive 167, Iron Mountain, Mo. Injector steam pipe pulled out at collar at injector throttle connection, due to collar being improperly applied; injector bracket stud broken off, placing weight and vibration of injector entirely upon piping; 1 injured.

**August 20, 1919, locomotive 5202, Arcadia, Mo. Injured while attempting to operate screw reversing gear; threads in brass nut which controls reversing gear stripped; 1 injured.

**August 22, 1919, locomotive 134, Illmo, Mo. Squirt hose burst; 1 injured.

August 23, 1919, locomotive 517, McManis Spur, Ark. Squirt hose valve worked open, due to loose packing nut; 1 injured.

September 1, 1919, locomotive 38, Arcadia, Mo. Scalded by hot water from squirt hose; due to squirt hose valve leaking; 1 injured.

** September 3, 1919, locomotive 2336, Dermott, Ark. Injured while operating reverse lever; insufficient clearance between reverse lever and injector, due to reverse lever being too long; 1 injured.

September 4, 1919, locomotive 2332, Bigelow, Kans. Water glass burst; cut by flying glass; shield removed at time of accident; 1 injured.

September 5, 1919, locomotive 9605, St. Louis, Mo. Gauge cock bonnet blew off, due to threads in gauge cock stripped; 1 injured.

September 9, 1919, locomotive 885, Helena, Ark. Footboard on locomotive too low, catching on frog and bending bracket; 1 injured.

September 11, 1919, locomotive 2384, near Nebraska City, Nebr. Squirt hose burst; 1 injured.

September 13, 1919, locomotive 529, Wynne, Ark. Air pump steam valve handle came off, permitting brakeman to fall to ground as he was going from cab to pilot and using valve handle for handhold; nut missing from valve stem; 1 injured.

September 16, 1919, locomotive 9439, Hoxie, Ark. Cap blew off of discharge pipe to blow-off cock; cap had been applied on account of blow-off cock leaking; 1 injured.

* September 26, 1919, locomotive 40, Annapolis, Mo. Water glass burst; cut by flying glass; 1 injured.

September 29, 1919, locomotive 2395, Addis La. Lubricator glass burst; cut by flying glass; shield too large to form proper fit; 1 injured.

October 3, 1919, locomotive 5533, near Garner, Ark. Squirt hose burst; 1 injured.

October 6, 1919, locomotive 2357, Adrian, Mo. Injector steam pipe spanner nut blew off nipple, due to loose fit; 1 injured.

** October 7, 1919, locomotive 2721, near Collins, Ark. Injured while operating throttle lever, due to throttle-lever latch and ratchet worn and would not hold lever in desired position; 1 injured.

October 24, 1919, locomotive 6, near Millwood, Ark. Squirt hose burst; 1 injured.

** October 28, 1919, locomotive 405, McGehee, Ark. Injured while operating reverse lever; insufficient clearance between reverse lever and throttle lever, due to reverse lever being too long; 1 injured.

** November 11, 1919, locomotive 476, McGehee, Ark. Scalded, due to check valve at front end of blower pipe leaking; 1 injured.

November 15, 1919, locomotive 2378, Bonita, La. Injured while cleaning out

November 18, 1919, locomotive 3610, Pine Bluff, Ark. Injured while operating throttle; lost motion in throttle lever and connections, permitting lever to move sufficiently to cause latch to drop below ratchet, preventing closing of throttle; throttle-lever guide missing; 1 injured.

November 20, 1919, locomotive 2512, Nevada, Mo. Blow-off cock broke off at nipple connection; 1 injured.

December 5, 1919, locomotive 1242, near Clafin, Kans. Crown sheet failure; low water; operating without water glass; improper cab lights, due to failure of headlight generator which was found seriously worn and in a most defective condition; 2 injured.

December 22, 1919, locomotive 2716, near White, Ark. Injured while operating shaker bar, due to lost motion in shaker rigging; 1 injured.

December 31, 1919, locomotive 457, Lake Providence, La. Boiler check stuck open; injured while attempting to seat check; 1 injured.

January 13, 1920, locomotive 9448, Kansas City, Kans. Ash-pan blower pipe broke at elbow connection while attempting to operate ash-pan blower valve from ground, due to extension handle being disconnected; old fracture in pipe at point of failure; 1 injured.

January 16, 1920, locomotive 3632, Dermott, Ark. Left cab seat fell, due to being improperly applied; 1 injured.

January 22, 1920, locomotive 510, North Little Rock, Ark. Water glass burst, cut by flying glass; 1 injured.

January 26, 1920, locomotive 428, Wynne, Ark. Shaker bar slipped off lever, due to improper fit; 1 injured.

February 5, 1920, locomotive 2704, near Dermott, Ark. Right cab seat fell, injuring engineer; leg supporting seat not securely attached; 1 injured.

February 13, 1920, locomotive 533, North Little Rock, Ark. Scalded by hot water from blow-off cock pipe, due to clamp missing and pipe loose; 1 injured.

February 15, 1920, locomotive 2337, McCall, La. Injured while operating reverse lever; foot-rest bolt at front end of quadrant worked out of place; threads on bolt too small, permitting nut to work off; 1 injured.

* March 5, 1920, locomotive 1819, Kansas City, Kans. Injured while shaking grates, due to shaker bar becoming disconnected; 1 injured.

March 11, 1920, locomotive 2704, near Dermott, Ark. Fire-box door latch broken, and would not hold door open while firing locomotive; 1 injured.

March 19, 1920, locomotive 6406, Gurdon, Ark. Cover broken off tool box on top of tender, causing fireman to fall; 1 injured.

March 26, 1920, locomotive 480, McGehee, Ark. Uncoupling-lever chain on locomotive disconnected; clevis bolt missing; 1 injured.

* April 1, 1920, locomotive 528, Kniveton, Kans. Water glass burst; cut by flying glass; 1 injured.

April 5, 1920, locomotive 2736, Tipton, Mo. Water glass burst; shield removed at time of accident; 1 injured.

* April 10, 1920, locomotive 2385, Beloit, Kans. While holding to flag box attempting to close broken throttle lever flag box came loose from cab, permitting engineer to fall; 1 injured.

April 13, 1920, locomotive 9469, Omaha, Nebr. Smoke consumer valve bonnet blew out; bonnet applied cross threaded; 1 injured.

* April 17, 1920, locomotive 9407, St. Louis, Mo. Eccentric strap broke, causing reverse lever to jump out of place; 1 injured.

* April 30, 1920, locomotive 1229, Pacific, Mo. Fire door came off fulcrum pin; threads stripped off bolt; 1 injured.

May 5, 1920, locomotive 410, near Samples, Ark. Injured while operating reverse lever; insufficient clearance between lever and boiler head; 1 injured.

May 22, 1920, locomotive 69, Grande Glaise, Ark. Squirt hose burst; defective hose; 1 injured.

May 30, 1920, locomotive 3614, Fort Smith, Ark. Squirt hose burst; defective hose; 1 injured.

May 31, 1920, locomotive 1256, Gore, Okla. Shaker bar slipped off lever, due to improper fit of bar on lever; 1 injured.

June 1, 1920, locomotive 1810, Hoyt, Ark. Piece broken from end of cab, allowing bolt to protrude above cab floor, causing employee to fall; 1 injured.

* June 2, 1920, locomotive 1815, North Little Rock, Ark. Slipped and fell from running board, due to running board being loose; 1 injured.

* June 5, 1920, locomotive 2618, Pine Bluff, Ark. Engine seat fell, due to defective bolt; 1 injured.

June 10, 1920, locomotive 541, Elaine, Ark. Air compressor steam pipe broke while attempting to stop leak under pressure; 1 injured.

June 18, 1920, locomotive 405, McGehee, Ark. Tender sill step broken, causing engineer to fall; defect reported day previous to accident and report approved indicating repairs made. Defect was not repaired; 1 injured. Fifty-seven accidents; 58 injured.

MOBILE & OHIO RAILROAD:

* November 26, 1919, locomotive 348, Clamore, Tenn. Squirt hose blew off nipple; 1 injured.

* June 7, 1920, locomotive 33, Meridian, Miss. Scalded by hot water from squirt hose; 1 injured.

Two accidents; 2 injured.

NASHVILLE, CHATTANOOGA & ST. LOUIS RAILWAY:

* August 13, 1919, locomotive 761, Atlanta, Ga. Injured while operating reverse lever, due to counter-balance spring breaking; 1 injured.

October 12, 1919, locomotive 619, McKenzie, Tenn. Key in front end of right main rod broke and was thrown through front door of cab, striking engineer; old flaw in key; 1 injured.

November 15, 1919, locomotive 609, Vaughns Gap, Tenn. Drawbar and safety chains broke, permitting locomotive and tender to separate; material in drawbar crystalized, and safety chains too long; 1 injured.

** December 5, 1919, locomotive 601, Tennessee City, Tenn. Ash-pan rigging caught on obstruction under locomotive, breaking pin in ash-pan lever, causing lever to strike fireman; 1 injured.

Four accidents; 4 injured.

NEVADA NORTHERN RAILWAY:

* June 22, 1920, locomotive 40, Hiline, Nev. Squirt-hose nipple blew off; 1 injured.

One accident; 1 injured.

NEW YORK CENTRAL RAILROAD—LINES EAST:

* July 11, 1919, locomotive 2565, Fort Johnson, N. Y. Fire-box door fell off; 1 injured.

July 14, 1919, locomotive 3174, near Kingston, N. Y. Crown sheet failure; low water; no contributory causes found. Appurtenances destroyed and damaged by explosion to such extent that their condition could not be determined; 3 killed.

August 27, 1919, locomotive 2554, near Brockport, N. Y. Crown sheet failure; low water; injectors would not work only when water valve was in certain position, and with no warning port the injector would blow back in tank without any visible indications; 3 injured.

* September 19, 1919, locomotive 3134, Rochester, N. Y. Shaker bar pulled off, due to cotter key missing; 1 injured.

October 16, 1919, locomotive 2530, West Albany, N. Y. Bull's-eye lubricator glass blew out; defective glass; 1 injured.

November 9, 1919, locomotive 3385, Reusselaer, N. Y. Coupling nut blew off of steam-heat valve; nut improperly fitted, and threads on valve stripped; 1 injured.

** December 31, 1919, locomotive 3472, Port Byron, N. Y. Flue broke at weld; overheated in welding; 1 injured.

February 15, 1920, locomotive 3926, West Albany, N. Y. Arch tube plug blew out; attempted to tighten under pressure; plug insecurely applied; 1 injured.

March 30, 1920, locomotive 166, Canadaigua, N. Y. Driving spring hanger broke and struck arch tube plug in throat sheet, knocking plug out; 1 injured.

May 6, 1920, locomotive 108, New York, N. Y. Water glass burst; cut by flying glass; 1 injured.

May 20, 1920, locomotive 4477, Chicago, Ill. Main air reservoir exploded; metal reduced in thickness to one-thirty-second inch at point of rupture, due to corrosion; 2 injured.

Eleven accidents; 3 killed, 13 injured.

NEW YORK CENTRAL RAILROAD—LINES WEST:

August 18, 1919, locomotive 829, Extine, Ill. Injured while operating reverse lever; stop pin missing from reverse lever quadrant, causing engineer's hand to be caught between lever and brake pipe; 1 injured.

September 17, 1919, locomotive 4375, Kankakee, Ill. Right front spring hanger broke, allowing front foot board to strike rail; old break in pin; 1 injured.

December 3, 1919, locomotive 3799, West Portland, N. Y. Flue broke at safe end weld; overheated in welding; 1 injured.

** January 10, 1920, locomotive 843, Kankakee, Ill. Water glass burst, cut by flying glass; glass panel in shield loose; 1 injured.

January 13, 1920, locomotive 5679, La Porte, Ind. Washout plug blew out, due to being inserted cross-threaded or not tightened when applied; 1 injured.

February 18, 1920, locomotive 5281, near Adams, Ill. Left driving wheel journal broke, causing cylinder head, piston head, and piston rod to be knocked out, breaking main rod and two side rods, guide yoke, two guide bars, cross-head and two crosshead shoes; also breaking right side rod; old flaw in journal; 1 injured.

March 21, 1920, locomotive 3853, Spencerport, N. Y. Flue broke at weld; overheated in welding; 1 injured.

* April 8, 1920, locomotive 4493, Rockport, Ohio. Backstop missing from footboard of engine; 1 injured.

** April 9, 1920, locomotive 5995, Air Line Junction, Ohio. Water glass burst; cut by flying glass; 1 injured.

* May 18, 1920, locomotive 3974, Graytown, Ohio. Injured while shaking grates, due to pin losing out; 1 injured.

** May 20, 1920, locomotive 2649, near La Porte, Ind. Nipple in air pipe to power reverse valve chamber came out, causing brakes to apply in emergency; nipple insecurely applied; 1 injured.

* June 8, 1920, locomotive 2601, Springfield, Pa. Injured while operating firebox door, due to top part of door being worn and bottom half of door broken; 1 injured.

Twelve accidents; 12 injured.

NEW YORK, CHICAGO & ST. LOUIS RAILROAD:

February 12, 1920, locomotive 405, Cleveland, Ohio. Arch tube plug blew out of back head; attempted to tighten under pressure; plug applied cross-threaded; 1 injured.

One accident; 1 injured.

NEW YORK, NEW HAVEN & HARTFORD RAILROAD:

* July 23, 1919, locomotive 808, Kent, Conn. Bolt connecting shaker bar to grates came out; 1 injured.

* August 7, 1919, locomotive 2421, Hartford, Conn. Locomotive and tender separated, due to defective channel bar which holds draw casting; 1 injured.

August 11, 1919, locomotive 1214, near Raynham, Mass. Blower pipe in front end became loose at union connection, due to pipe not being securely clamped, causing back draft; 2 injured.

** August 24, 1919, locomotive 339, Cedar, Mass. Injured while shaking grates; burnt pin in connection between shaker bar and grates; 1 injured.

** August 31, 1919, locomotive 1533, Boston, Mass. Injured while operating injector, due to packing leaking; 1 injured.

September 26, 1919, locomotive 1279, New Haven, Conn. Ashpan blower pipe became disconnected at elbow; defective threads on pipe and in elbow; 1 injured.

October 2, 1919, locomotive 412, Boston, Mass. Injured while operating shaker bar, due to bolt coming out of shaker lever post; 1 injured.

November 11, 1919, locomotive 3005, Bay Ridge, N. Y. Top water glass body gasket blew out, due to gasket cap not being securely tightened; 1 injured.

** December 18, 1919, locomotive 286 (point of accident not shown). Right pin journal broke, causing reverse lever to strike engineer; 1 injured.

** January 2, 1920, locomotive 208, Cedar Hill, Conn. Crown sheet failure; low water; gauge cock drip stopped up; bottom water glass cock stopped up with sediment; left tank valve closed; 1 injured.

January 3, 1920, locomotive 1012, Chestnut Hill, Conn. Mechanically operated door inoperative, due to bolt missing from operating lever; 1 injured.

* January 4, 1920, locomotive 161, Hawleyville, Conn. Coal door on tender popped off hinges, due to hinges being rusted thin; 1 injured.

** January 4, 1920, locomotive 802, South Norwalk, Conn. Blower valve gasket blew out; 1 injured.

January 4, 1920, locomotive 848, Wheaton, Conn. Crown sheet failure; low water; gauge cock drip and pipe stopped up; 1 injured.

January 15, 1920, locomotive 1310, near Franklin Junction, Mass. Superheater unit broke at tee bolt connection; 1 injured.

February 4, 1920, locomotive 326, Thompsonville, Conn. Injured while operating reverse lever, due to connecting rod on reverse lever latch breaking; 1 injured.

February 11, 1920, locomotive 1094, Windsor Lock, Conn. Collar on brazing nipple of lubricator pipe broke off; old fracture in nipple; 2 injured.

February 16, 1920, locomotive 1569, Campello, Mass. Scalded by hot water from steam heat valve; valve leaking; 1 injured.

February 18, 1920, locomotive 2333 New Bedford, Mass. Bullseye lubricator glass blew out; 1 injured.

* March 15, 1920, locomotive 1344, Providence, R. I. Shaker bar slipped off lever; 1 injured.

April 11, 1920, locomotive 331, Waterbury, Conn. Shaker post broke off at top connection while fireman was shaking grates; old flaw in post; 1 injured.

May 8, 1920, locomotive 284, North Haven, Conn. Injured while hooking fire, due to arch brick falling down in firebox; 1 injured.

** May 24, 1920, locomotive 3104, Bay Ridge, N. Y. Flue broke; overheated in welding; 1 injured.

May 25, 1920, locomotive 2523, Cedar Hill, Conn. Nipple came off end of fire hose; nipple not properly applied; 1 injured.

June 10, 1920, locomotive 1369, near West Canton Junction, Mass. Side rod broke at knuckle joint; 1 injured.

June 13, 1920, locomotive 1008, Burnside Junction, Conn. Piston key in cross-head broke, which allowed piston head to move forward and knock out cylinder head; 1 injured.

June 16, 1920, locomotive 208, Westfield, Mass. Throttle gland blew out, due to studs breaking off; 2 injured.

June 18, 1920, locomotive 398, Coventry, R. I. Injured while shaking grates; shaker rods disconnected, due to pins losing out; 1 injured.

Twenty-eight accidents; 31 injured.

NEW YORK, SUSQUEHANNA & WESTERN RAILROAD:

October 13, 1919, locomotive 100, Halsey, N. J. Flue broke at weld; overheated in welding; 1 injured.

January 28, 1920, locomotive 92, Little Ferry, N. J. Flue broke at weld; overheated in welding; flue reduced 50 per cent in thickness at point of failure; 1 injured.

March 26, 1920, locomotive 126, North Paterson, N. J. Injector delivery pipe spanner nut pulled loose, due to improper application; 1 injured.

Three accidents; 3 injured.

NORFOLK & WESTERN RAILROAD:

July 3, 1919, locomotive 106, Crewe, Va. Electrically welded seam around patch and seam in bottom of combustion chamber failed; 1 injured.

August 5, 1919, locomotive 585, Berryville, Va. Injured while operating reverse lever, due to bottom bolt losing out of back end of right valve rod guide, letting valve rod down and striking guide yoke, breaking right radius rod and bending rocker arm; 1 injured.

* September 4, 1919, locomotive 1030, Ashville, Ohio. Injured while operating reverse lever, due to lever being bent; 1 injured.

* October 4, 1919, locomotive 443, Miner, Ohio. Scalded by steam and hot water from squirt hose, due to boiler check failing to seat properly; 1 injured.

October 9, 1919, locomotive 394, near Winchester, Ohio. Flue broke at butt weld; old defect three-fourths the circumference of flue; 1 injured.

November 24, 1919, locomotive 1034, St. James, Md. Reverse lever flew out of quadrant, due to latch spring breaking; 1 injured.

** December 1, 1919, locomotive 599, Shenandoah, Va. Shaker bar slipped off lever; locomotive not equipped with proper shaker bar; 1 injured.

December 5, 1919, locomotive 1423, Williamson, W. Va. Arch tube pulled out of throat sheet; tube extended into sheet only five-sixteenths inch at bottom and one-half inch at top (not through sheet), and not belled or beaded to hold it in place; 2 injured.

** December 14, 1919, locomotive 458, White Post, Va. Injured while operating shaker bar; insufficient clearance between shaker bar and injector ram extension handle; 1 injured.

December 16, 1919, locomotive 1146, Cloverdale, Va. Cab step became loose, causing party to fall; one bolt missing from step and the other bolt loose; work report for December 12 states, "Tighten left engine step"; 1 injured.

December 21, 1919, locomotive 585, Stanley, Va. Injured while operating shaker bar; no clearance between shaker bar and handhold on boiler head; 1 injured.

December 30, 1919, locomotive 1026, near Otway, Ohio. Drawbar and safety chains failed, permitting locomotive and tender to separate; loose chafing casting on tail brace of locomotive working three-eighths inch, 1-inch bolts applied in 1½-inch holes; cast-iron chafing buffer on tender working and hanging out 1 inch at top, with 1-inch bolts used in 1½-inch holes; 1¼ inches lost motion in draw gear; drawbar pocket casting on tender loose and working vertically one-half inch and seven rivets sheared off (old defects); left safety chain lewis 4¼ inches, applied over a 3½-inch fit, with 1¼-inch pins, when 1½-inch pins would have been used; faces of wedge and buffer casting worn flat, 8½ inches wedge and buffer on tender 8¼ inches; lost motion between engine and tender reported on December 6 and 28, and work reports approved, indicating repairs had been made, while our investigation after accident showed conclusively that the defects reported had not been remedied; 1 killed.

January 16, 1920, locomotive 1319, Rodderfield, W. Va. Injured while operating reversing gear; corner of slots on main reverse bar latch plate badly worn, and lugs on auxiliary reverse lever worn; 1 injured.

January 16, 1920, locomotive 770, Idlewild, Ohio. Flue broke at weld; defective weld; 1 injured.

February 1, 1920, locomotive 1383, Houchins, Va. Flue broke at butt weld; old fracture in flue and overheated in welding; 2 injured.

* March 12, 1920, locomotive 105, Lynchburg, Va. Jet valve fitting blew out, due to defective threads; 1 injured.

April 25, 1920, locomotive 964, Wilco, W. Va. Nut worked off valve rod locker arm bolt, allowing bolt to come out and front end of transmission valve rod to drop down and come in contact with crosshead, causing nut to strip off reverse bar latch bolt; 1 injured.

May 22, 1920, locomotive 432, Glade Springs, Va. Right crosshead failed, due to crack ½ inch deep just back of piston-rod hub; repairs were made by electric welding; welding failed within a few days, causing front cylinder head to be knocked out, fatally injuring conductor, who was on pilot-sill step; 1 killed.

* May 31, 1920, locomotive 1143, Crewe, Va. Fell from engine, due to throttle valve rod to air pump pulling out at joint; 1 injured.

June 5, 1920, locomotive 2008, West Roanoke, Va. Crown sheet failure; low water; left top water glass cock found closed; 1 killed, 1 injured.

Twenty accidents; 3 killed, 20 injured.

NORFOLK SOUTHERN RAILWAY:

* June 16, 1920, locomotive 130, Dover, N. C. Injured while shaking grates, due to shaker bar becoming disconnected; 1 injured.

One accident; 1 injured.

NORTHERN PACIFIC RAILWAY:

July 8, 1919, locomotive 270, Palouse, Wash. Lubricator glass burst; burned by escaping hot oil; 1 injured.

** July 22, 1919, locomotive 1681, Milwaukee Crossing, N. Dak. Engineer scalded by hot water from split branch pipe; 1 injured.

August 10, 1919, locomotive 1743, Glendive, Mont. Reverse lever latch bolt broke, causing lever to fly out of quadrant; 1 injured.

August 18, 1919, locomotive 1809, Helena, Mont. Engineer's hand caught between reverse lever and air pipe; reverse-lever air control latch badly worn; 1 injured.

September 11, 1919, locomotive 917, Tacoma, Wash. Bottom guides of ashpan broke, allowing slides to fall down and strike track; 1 injured.

September 17, 1919, locomotive 56, Auburn, Wash. Lubricator glass burst; cut by flying glass; 1 injured.

September 25, 1919, locomotive 2380, Little Falls, Minn. Squirt hose valve worked open, due to loose packing nut; 1 injured.

November 2, 1919, locomotive 1524, Northtown, Minn. Steam turbine burst; 1 injured.

December 19, 1919, locomotive 39, Mandan, N. Dak. Hinges on manhole cover broken and deteriorated, causing fireman to fall; 1 injured.

December 27, 1919, locomotive 1698, Sumas, Wash. Uncoupling-lever bracket on pilot beam of locomotive broke, allowing uncoupling lever to slip while being used by brakeman as handhold; 1 injured.

January 10, 1920, locomotive 1791, Mandan, N. Dak. Injured due to reverse-lever flying forward; one spring missing from bottom of reverse-lever latch block; 1 injured.

January 17, 1920, locomotive 2195, Lester, Wash. Burned by hot grease from grease cup on left main rod; rod running hot, due to grease-cup plunger sticking; 1 injured.

January 30, 1920, locomotive 1704, Grey Cliff, Mont. Injured while operating shaker bar, due to bar slipping off lever; 1 injured.

February 22, 1920, locomotive 1710, Grey Cliff, Mont. Injured while attempting to operate air reverse gear; 1 injured.

**March 17, 1920, locomotive 2152, Wadena, Minn. Insufficient clearance between reverse lever and back head; 1 injured.

*May 17, 1920, locomotive 140, Yardley, Wash. Packing nut on steam valve to lubricator burst; 1 injured.

*June 26, 1920, locomotive 2390, LaMoure, N. Dak. Defective elbow connection on steam pipe between engine and Ledgerwood; 1 injured.

Seventeen accidents; 17 injured.

OREGON SHORT LINE RAILROAD.

* July 24, 1919, locomotive 2025, Bancroft, Idaho. Dome casing cap blown off; cap not fastened; 1 injured.

April 30, 1920, locomotive 589, McMillan, Idaho. Blow-off cock extension handle became disconnected while locomotive was running at a speed of 25 miles per hour, front end catching on road bed and back end driven through cab bracket into gangway; 1 injured.

May 20, 1920, locomotive 2024, Dietrich, Idaho. Blow-off cock handle broke; 1 injured.

Three accidents; 3 injured.

OREGON-WASHINGTON RAILROAD & NAVIGATION CO.

July 17, 1919, locomotive 740, Kamela, Oreg. Squirt hose parted at splice; hose insecurely clamped; 1 injured.

*August 17, 1919, locomotive 4909, Albina, Oreg. Fireman burned while attempting to relight headlight, due to gas hose being disconnected; 1 injured.

August 21, 1919, locomotive 705, Kellogg-Warden, Idaho. Hose applied to drain valve of injector delivery pipe blew off nipple; hose not clamped; 1 injured.

* March 7, 1920, locomotive 2169, Duncan, Oreg. Squirt hose burst; 1 injured.

Four accidents; 4 injured.

PENNSYLVANIA RAILROAD—WESTERN LINES.

* July 1, 1919, locomotive 7044, Ada, Ohio. Squirt pipe burst; 1 injured.

August 20, 1919, locomotive 1192, Mahoningtown, Pa. Studs holding gauge cock flange against ball joint on boiler head broke off while attempting to tighten with 50 pounds pressure on boiler; studs of poor material; 2 injured.

September 20, 1919, locomotive 7642, Leetsdale, Pa. Boiler check cap blew out; cap too small for opening in check, and cap badly damaged by use of hammer and set used in removing and replacing; 2 injured.

* September 27, 1919, locomotive 8374, Indianapolis, Ind. Injured while shaking grates, due to shaker bar being bent and slipping off of fulcrum lever; 1 injured.

* September 30, 1919, locomotive 103 (G. R. & I.), Moline, Mich. Cap blew off of main grease plug; 1 injured.

* October 2, 1919, locomotive 7406, Ambridge, Pa. Step flew off locomotive while running at a speed of 40 miles per hour; 1 injured.

* October 21, 1919, locomotive 7779, Edenburg, Pa. Struck by bolt flying from coupler of locomotive while running at a speed of 50 miles per hour; 1 injured.

October 28, 1919, locomotive 8421, Swietser, Ind. Flue broke at weld; defective weld; 1 injured.

* November 1, 1919, locomotive 7139, Perryville, Ohio. Grease cup plug blew out; 1 injured.

November 11, 1919, locomotive 8648, Scully, Pa. Fountain valve hood blew off, due to loose fit; threaded portion of hood three-sixty-fourth inch larger in diameter than body of valve; 1 injured.

November 16, 1919, locomotive 18184, Carnegie, Pa. Injector delivery pipe spanner nut broke; nut showed evidence of previous use of hammer and set in tightening; 1 injured.

*December 10, 1919, locomotive 7467, Salem, Ohio. Flue broke at weld; defective weld; 1 injured.

*December 16, 1919, locomotive 103 (G. R. & I.), Decatur, Ind. Bolt came out of cab apron, causing apron to shift, permitting fireman to fall between engine and tender; 1 injured.

December 17, 1919, locomotive 9968, Conway, Pa. Flue broke; 1 injured.

December 22, 1919, locomotive 7681, West Rochester, Pa. Crown-sheet failure; low water; both water-glass cocks found closed at time of investigation; when mechanics made repairs to water-glass cocks they were closed, and it is believed they were not opened up after repairs were completed. Accident occurred 1 hour and 50 minutes after crew took charge; water was 10 inches below crown sheet when accident occurred; 2 injured.

*January 10, 1920, locomotive 7762, Englewood, Ill. Collar of steam pipe to stoker engine blew off; 2 injured.

*January 22, 1920, locomotive 7546, Island Avenue yard. Flue burst; 1 injured.

January 29, 1920, locomotive 8504, Steubenville, Ohio. Injector delivery pipe burst, due to being wasted away to one thirty-second inch in thickness at point of failure, and boiler check failed to seat when injector was shut off; 1 injured.

February 2, 1920, locomotive 7475, near Bedford, Ohio. Left front bottom guide bolt broke or lost out, causing guide to drop down and strike roadbed, bending guide yoke back and throwing link frame and reach rod up against reach-rod lifting lever on tumbling shaft, causing reverse lever to become unattached; reverse lever latch spring weak; 1 injured.

February 18, 1920, locomotive 7079, Clarksville, Pa. Left front driving wheel tire broke while locomotive was engaged in double-heading passenger train, derailing both locomotives and four cars; tires of unequal diameters; daily inspection reports from January 14 to date of accident bear numerous notations indicating tires to be in a defective condition; reports for January 15 and 18 and February 13 and 15 state "Left front tire loose"; 3 injured.

*February 21, 1920, locomotive 8332, West Manchester, Ohio. Flue burst; 1 injured.

*March 27, 1920, locomotive 8262, Indianapolis, Ind. Injured while shaking grates, due to shaker-bar socket being too large for post; 1 injured.

**April 4, 1920, locomotive 8074, Marble Cliff, Ohio. Injured while firing locomotive; bolt missing from pedal valve, automatic stoker, permitting pedal to drop down; fire-door guides loose; 1 injured.

**April 9, 1920, locomotive 8004, Richmond, Ind. Handhold broke, permitting engineer to fall; old defect in handhold; 1 injured.

*May 23, 1920, locomotive 8257, Indianapolis, Ind. Wooden plug blew out of main steam pipe extending from spider to stoker engine; 1 injured.

*May 28, 1920, locomotive 7765, Chicago, Ill. Feed glass of lubricator broke; defective glass; 1 injured.

*June 9, 1920, locomotive 9, Portland, Ind. Oil cup flew off of engine while running at a speed of 25 miles per hour, striking employee; 1 injured.

*June 10, 1920, locomotive 7791, Shreve, Ohio. Stoker steam pipe on left side of engine burst; 1 injured.

Twenty-eight accidents; 34 injured.

PENNSYLVANIA RAILROAD—EASTERN LINES:

July 6, 1919, locomotive 345, East Altoona, Pa. Wash-out cap blew out while attempting to tighten under pressure; defective threads on washout flange, and cap cross-threaded; 1 injured.

** July 23, 1919, locomotive 3333, Corydon, Pa. Oil step brace flew from locomotive while running at a speed of 60 miles per hour; 1 injured.

* July 26, 1919, locomotive 2020, Orton, Pa. Blower pipe cap blew off; 1 injured.

August 22, 1919, locomotive 726, Philadelphia, Pa. Blow-off cock blew out; attempted to tighten under pressure; defective threads on nipple of blow-off cock, and blow-off cock applied cross-threaded; 1 injured.

*August 23, 1919, locomotive 5393, near Stanton, Del. Flue burst; 1 injured.

August 27, 1919, locomotive 4198, Baltimore, Md. Arch tube washout plug blew out; attempted to tighten under pressure; threads on plug and in sheet defective, and plug insecurely applied; 3 injured.

* September 1, 1919, locomotive 6075, Winslow Junction, N. J. Scalded by hot water from leaky flue; 1 injured.

September 3, 1919, locomotive 531, Greensburg, Pa. Cab bracket stud blew out; studs on stud practically worn away, and threads in stud hole defective;

September 10, 1919, locomotive 1730, Eltonburg, Pa. Injector overflow valve spanner nut blew off; spanner nut too large and threads stripped; nut showed evidence of previous tightening by use of hammer and set; 1 injured.

September 14, 1919, locomotive 2596, South Fork, Pa. Steam pipe connection to dry pipe in smoke box broke, causing back draft; 1 injured.

*September 14, 1919, locomotive 3619, Philadelphia, Pa. Squirt hose burst; 1 injured.

September 20, 1919, locomotive 3334, Millstone Junction, N. J. Oiling step brace thrown from locomotive while running 55 miles per hour, due to bolts securing it in place being loose and badly worn; 1 killed.

September 26, 1919, locomotive 112, Philadelphia, Pa. Cab apron caught between cab and bulk head of feed water tank while locomotive was rounding curve, breaking both eye bolts of cab apron hinge; 1 injured.

*October 6, 1919, locomotive 3426, near Mount Joy, Pa. Reverse lever slipped out of quadrant, due to worn notches in quadrant; 1 injured.

*October 10, 1919, locomotive 3077, Trenton, N. J. Lubricator drain cock blew off, due to old flaw; 1 injured.

October 15, 1919, locomotive 1837, West Brownsville Junction, Pa. Washout plug blew out; attempted to tighten under pressure; plug too small for hole in sheet, and applied cross-threaded; 1 injured.

October 19, 1919, locomotive 224, Blairsville, Pa. Flue broke at weld; defective weld; 1 injured.

**October 21, 1919, locomotive 1397, Lawrence, N. J. Washer thrown from driving brake hanger post, while locomotive was running at a speed of 60 miles per hour; cotter pin missing from brake hanger post; 1 injured.

November 6, 1919, locomotive 763, Philadelphia, Pa. Joint of Klinger type water glass blew out; 1 injured.

*November 6, 1919, locomotive 3465, Ryde, Pa. Flue burst; 1 injured.

November 10, 1919, locomotive 81 (C. V.), Marion, Pa. Lubricator steam pipe broke at boiler connection, due to old fracture in bushing; 1 injured.

**November 17, 1919, locomotive 6262, Shintown, Pa. Ashpan door and connecting rods came down, due to pins working out of rods, while locomotive was running at a speed of 50 miles per hour; 1 injured.

November 20, 1919, locomotive 2709, Renovo, Pa. Top portion of washout cap blew off; old fracture in cap; 1 injured.

November 27, 1919, locomotive 3325, New Brunswick, N. J. Side-rod collar and pin plate worked loose and thrown from locomotive while running at a speed of 60 miles per hour, due to being insecurely applied; 1 injured.

*December 2, 1919, locomotive 3642, Lilly, Pa. Collar of blow-off pipe pulled out; 1 injured.

December 10, 1919, locomotive 1762, Riverton, N. J. Grease cup on right main rod burst; bushing and back end brass of rod improperly assembled, and bushing keeper loose, causing bearing to become hot; 1 injured.

December 21, 1919, locomotive 1584, near Aspinwall, Pa. Flue broke; flue corroded and entirely wasted away at point of failure; 1 injured.

*December 21, 1919, locomotive 3549, Carrolltown, Pa. Injured while operating reverse lever, due to worn reverse-gear rigging; 1 injured.

December 28, 1919, locomotive 5017, Philadelphia, Pa. Steam-heat valve blew out of turret; threads on valve and in turret defective and loose fitting; stem of valve only screwed in four threads. This connection had been reported leaking on December 27 and 28, and had been called to the personal attention of enginehouse foreman, yet proper repairs were not made; 1 killed.

January 18, 1920, locomotive 1105, Trenton, N. J. Injector-ram bonnet blew out while attempting to tighten by use of hammer and wrench; threads on bonnet stripped, and bonnet badly mutilated by use of chisel or set in tightening at previous times. Injectors reported 17 times from January 3 to January 18, and reports approved, indicating repairs made; 2 injured.

January 18, 1920, locomotive 197, Philadelphia, Pa. Injector-ram bonnet blew out; defective threads on bonnet and in body of injector; 2 injured.

January 30, 1920, locomotive 6337, Bradenville, Pa. Squirt pipe failed at union, due to improper fit; 1 injured.

**February 5, 1920, locomotive 2631, Phillipston, Pa. Defective tender-brake rigging; had been properly reported, but not repaired by shop people; while engineer was under tender making repairs train was bumped into from rear; 1 injured.

*February 6, 1920, locomotive 1829, Enola, Pa. Reverse lever flew back, due to worn quadrant; 1 injured.

*February 9, 1920, locomotive 3505, near Chase, Md. Piece of frame over ventilator door fell on fireman's foot, due to wood being rotten; 1 injured.

February 15, 1920, locomotive 6218, Oil City, Pa. Handrail on top of tender broke, permitting fireman to fall; 1 injured.

March 10, 1920, locomotive 2931, Pittsburgh, Pa. Injector-globe valve blew out at connection to fountain; valve insecurely applied; defective threads on valve and in fountain; 3 injured.

*March 23, 1920, locomotive 6308, Moritz, N. Y. Injured while shaking plates, due to shaker bar being too large for post; 1 injured.

March 26, 1920, locomotive 2608, Connellsville, Pa. Advance link hanger and bolts worked out, permitting motion work to drop, causing reverse lever strike engineer; 1 injured.

**April 2, 1920, locomotive 430, near Centerville, Pa. Locomotive 430 was assisting locomotive 89 in pulling a passenger train, and while traveling at a speed of 40 miles per hour the right front spring hanger failed, derailing and overturning both locomotives; 1 killed, 7 injured.

**April 3, 1920, locomotive 1464, East Altoona, Pa. Flue broke. At 11.59 a. m. on date of accident the following was reported: "Bad leak at front end of boiler; water runs out of smoke box; please examine." Report approved by foreman, indicating repairs made. Locomotive was called for 2.30 p. m. the same day, and accident occurred at 2.15 p. m., while locomotive was being repaired for service. According to company's records, locomotive was placed on a ready track for another run without proper attention being given to the defect reported; 1 injured.

*April 12, 1920, locomotive 1641, Roaring Branch, Pa. Throttle valve flew open, due to throttle latch being worn, causing locomotive to move while firing hot pin; 1 injured.

**April 15, 1920, locomotive 231, Odenton, Md. Right back engine truck axle-beam hanger broke; 1 injured.

**April 21, 1920, locomotive 3676, Deans, N. J. Sliding door dropped out of ventilator in cab roof, due to failure of bolts to hold door brace in place; 1 injured.

June 14, 1920, locomotive 2435, Stockdale, Pa. Left main rod failure, due to a crack about 35 per cent of cross-sectional area of rod; 1 injured.

Forty-five accidents; 3 killed, 55 injured.

THE MARQUETTE RAILWAY:

**August 8, 1919, locomotive 331, Saginaw, Mich. Stud blew out of throat nut; attempted to tighten under pressure; stud insecurely applied; 1 injured.

**August 8, 1919, locomotive 704, Saginaw, Mich. Scalded by steam and hot water while removing injector bonnet, due to boiler check leaking; 1 injured.

September 11, 1919, locomotive 348, near Reed City, Mich. Reducer bushing and squirt-pipe connection to injector delivery pipe broke; old defect in bushing; 1 injured.

*September 23, 1919, locomotive 483, Detroit, Mich. Bolt on underside of footboard caught on rail, causing footboard to double back; 1 injured.

December 3, 1919, locomotive 29, near Mecosta, Mich. Injured while operating ashpan blower; opening in right fork defective, causing steam to blow toward grates. Work report for December 1 states: "Examine ashpan blower; does not clean out right side of pan." Notation made on work report: "Fork found closed up, and was opened"; 1 injured.

January 14, 1920, locomotive 703, near Elmdale, Mich. Drawbar between locomotive and tender broke; metal crystallized and of light construction; 1 injured.

January 17, 1920, locomotive 402 (I. H. B.), Holley, Mich. Crownsheet failure; low water; operating without water glass; right water glass broken and left water glass shut off, due to gasket leaking badly; right water glass was reported 11 times previous to accident; notation on work reports: "No glass for this type engine"; 1 killed, 2 injured.

**January 22, 1920, locomotive 1088 (U. S. A.), Toledo, Ohio. Arch tube washout plug blew out; attempted to tighten under pressure; formation of graphite on plug and around hole, preventing plug from being securely applied to sheet; threads on plug and in sheet defective; 1 injured.

February 3, 1920, locomotive 489, Detroit, Mich. Handhold pulled off front end of locomotive, due to being insecurely applied; 1 killed.

Nine accidents; 2 killed, 9 injured.

PEORIA & PEKIN UNION RAILWAY:

August 30, 1919, locomotive 2, Peoria, Ill. Washout cap blew out; attempted to tighten under pressure; threads on cap stripped; 1 injured.
One accident; 1 injured.

PHILADELPHIA & READING RAILWAY:

July 21, 1919, locomotive 572, Moselem, Pa. Nos. 2 and 4 tender truck wheels out of gauge, causing derailment of tender, engine, and two cars, while running backwards; 3 killed, 1 injured.

* November 18, 1919, locomotive 382, Shawmont, Pa. Reverse lever flew out of quadrant, due to defective valve motion and loose eccentric strap; 1 injured.

** December 17, 1919, locomotive 1611, Jenkintown, Pa. Gasket blew out of top gauge cock; gauge cock nipple missing and gauge cock improperly applied; 1 injured.

March 1, 1920, locomotive 1093, Hershey, Pa. Arch tube pulled out of flue sheet; tube not belled or beaded, due to only extending in hole flush with water side of sheet; 2 injured.

* April 14, 1920, locomotive 410, Chestnut Hill, Pa. While getting down from back of tank, top rung of ladder broke out, allowing fireman to fall; old flaw in iron; 1 injured.

June 27, 1920, locomotive 1096, West Milton, Pa. Cylinder head blew out, due to old fracture and water being worked through cylinders; 1 injured.

Six accidents; 3 killed, 7 injured.

PITTSBURGH & LAKE ERIE RAILROAD:

August 20, 1919, locomotive 9553, Hays, Pa. Crown sheet failure; low water; no contributory causes found; 2 injured.

One accident; 2 injured.

RUTLAND RAILROAD:

December 4, 1919, locomotive 148, New Lebanon, N. Y. Injector delivery pipe coupling nut broke while attempting to tighten; nut badly cut and mutilated, due to use of improper tools in tightening; 1 injured.

One accident; 1 injured.

ST. LOUIS-SAN FRANCISCO RAILWAY:

* August 1, 1919, locomotive 540, Bentley, Kans. Squirt hose burst; 1 injured.

August 7, 1919, locomotive 1407, Bigbee, Miss. Injector delivery pipe spanner nut blew off while attempting to tighten with injector in operation; threads on spanner nut stripped; 1 injured.

* September 19, 1919, locomotive 217, Belden, Miss. Spring hanger on locomotive broke, causing flat car on which employees were riding to derail; 5 injured.

September 26, 1919, locomotive 1320, near Munger, Okla. Crown sheet failure; low water; middle-gauge cock stopped up; 2 injured.

* October 7, 1919, locomotive 1064, Hancock, Mo. Cab apron worn smooth, causing fireman to fall; 1 injured.

October 20, 1919, locomotive 581, Frederick, Okla. Headlight turbine burst; both main bushings badly worn, causing turbine wheel to drag on housing of turbine and armature dragging in fields; turbine valve leaking badly and governor inoperative, permitting turbine to run at an excessive speed; defects reported by engineer on October 10, but repairs not made; 1 injured.

October 29, 1919, locomotive 504, Springfield, Mo. Wooden plug driven in washout hole in back head blew out; 2 injured.

December 25, 1919, locomotive 666, near Alston, Mo. Handhold on cab pulled off of bolts, permitting fireman to fall to ground, due to nut missing; 1 injured.

January 1, 1920, locomotive 24, Stoutland, Mo. Shaker bar became disconnected, due to pin connecting shaker rod to grates breaking or losing out; 1 injured.

January 9, 1920, locomotive 1068, near Lebanon, Mo. Lubricator steam pipe broke at throttle connection; unable to close lubricator throttle due to throttle being inoperative; 1 injured.

January 14, 1920, locomotive 10, Mountain Grove, Mo. Hinge on stoker hopper cover broke, causing cover to slip from its usual position, injuring fireman; 1 injured.

January 28, 1920, locomotive 819, Afton, Okla. Crown sheet failure; low water; no contributory causes found; 2 injured.

** February 6, 1920, locomotive 3720, Oklahoma City, Okla. Tank step loose, permitting employee to fall; 1 injured.

March 6, 1920, locomotive 3707, Birmingham, Ala. Crown sheet failure; low water; portions of water glass gaskets found in top and bottom water glass tanks; 2 killed.

** June 6, 1920, locomotive 624, Cyril, Okla. Squirt hose blew off; insecurely latched; 1 injured.

June 29, 1920, locomotive 2006, Coal Creek, Ala. Grease cup plug blew out due to pressure in cup caused by hot pin, account bushing turning in rod; 1 injured.

Sixteen accidents; 2 killed, 22 injured.

ST. LOUIS SOUTHWESTERN RAILWAY:

* September 12, 1919, locomotive 137, Malden, Mo. Lubricator filling plug blew out while attempting to tighten under pressure; 1 injured.

* May 31, 1920, locomotive 9472 (M. P.), Illinois, Mo. Squirt hose burst, defective hose; 1 injured.

Two accidents; 2 injured.

SEABOARD AIR LINE RAILWAY:

August 15, 1919, locomotive 1059, Portsmouth, Va. Electrically welded crack in knuckle of back boiler head failed; 1 injured.

September 3, 1919, locomotive 160, Millard, Fla. Crown sheet failure; low water; no contributory causes found; 1 killed.

* February 1, 1920, locomotive 18, Hamlet, N. C. Shaker bar slipped off lug, due to improper fit; 1 injured.

* March 10, 1920, locomotive 18, Gill, N. C. Main rod broke; 1 injured.

March 10, 1920, locomotive 1093 (U. S.), Hamlet, N. C. Scalded by hot water from defective squirt hose while attempting to operate injector; boiler neck leaking, and squirt-hose valve was opened in attempt to relieve pressure; sole worn in squirt hose; 1 injured.

* March 27, 1920, locomotive 802, Starke, Fla. Spindle to water-glass cock blew out; 1 injured.

* March 31, 1920, locomotive 1057, Jacksonville, Fla. Injured while operating reverse lever; insufficient clearance between brake valve and reverse lever; 1 injured.

* April 18, 1920, locomotive 200, Raleigh, N. C. Shaker bar slipped off lug, due to improper fit; 1 injured.

** April 26, 1920, locomotive 2009, East Junction, N. C. Air pipe blew out at main reservoir connection, due to threads stripping; 1 injured.

* April 28, 1920, locomotive 834, De Witt, Va. Shaker bar slipped off lug, due to improper fit; 1 injured.

April 28, 1920, locomotive 8017 (U. S. A.), Wilmington, N. C. Squirt-hose valve broke off; 1 injured.

* May 21, 1920, locomotive 618, McKenney, Va. Cylinder head on engine cracked, allowing water and steam to strike brakeman; 1 injured.

** June 11, 1920, locomotive 396, Middendorf, S. C. Shaker bar slipped off lever, due to improper fit; 1 injured.

** June 16, 1920, locomotive 401, Raleigh, N. C. Squirt-hose valve blew off; 1 injured.

June 26, 1920, locomotive 975, Raleigh, N. C. Arch tube washout plug blew out; plug applied cross threaded; attempted to tighten under pressure; 2 injured.

** June 27, 1920, locomotive 486, Garysburg, N. C. Fell from locomotive, due to improper construction of step; 1 injured.

Sixteen accidents; 1 killed, 16 injured.

SOUTHERN PACIFIC—EAST:

October 5, 1919, locomotive 451, Shreveport, La. Cylinder burst; old crack in cylinder, and cylinder worn three-eighths inch out of round; on arrival of locomotive at engine house on date of accident, cylinder was found cracked, all packing rings broken and cylinder three-eighths inch out of round; locomotive had new packing rings applied, and returned to service without other repairs to cylinder; 1 injured.

* October 11, 1919, locomotive 667 (L. W.), Kaplan, La. Cap on end of blow-off pipe blew off; 1 injured.

January 20, 1920, locomotive 504, Greens, Tex. Tank heater valve bonnet blew off; injured while attempting to replace bonnet; threads on bonnet badly

January 23, 1920, locomotive 440, Dallas, Tex. Nipple connection to blow-off valve in dome blew off; due to improper fit, and threads on nipple badly corroded; 1 injured.

January 29, 1920, locomotive 441, Dallas, Tex. Crown sheet failure; low water; four crown stays and four stay bolts broken; safety valves would not properly relieve pressure; top and bottom water glass cocks closed; 1 injured.

*June 25, 1920, locomotive 508, Houston, Tex. Injured while operating fire door, due to liner in fire door being broken; 1 injured.

Six accidents; 6 injured.

SOUTHERN PACIFIC—WEST:

July 29, 1919, locomotive 1190, Gerber, Calif. Injector steam pipe spanner nut blew off; attempted to tighten under pressure; nut too large for connection; 1 injured.

July 29, 1919, locomotive 1535, near Goshen Junction, Calif. Side rod on locomotive broke; 1 injured.

August 15, 1919, locomotive 2275, Tracy, Calif. Washout plug blew out; plug cross threaded; attempted to tighten under pressure; 2 injured.

September 22, 1919, locomotive 1778, near Kerman, Calif. Injured while attempting to inject bran into boiler through heater valve of injector; 1 injured.

November 4, 1919, locomotive 3642, Dragoon, Ariz. Brakes applied in emergency, due to excessive accumulation of dirt in dirt collector; 1 injured.

November 12, 1919, locomotive 1014, San Luis Obispo, Calif. Conductor struck by torch which was blown out of fireman's hand, due to explosion of gas in acetylene headlight; 1 injured.

December 15, 1919, locomotive 1233, Tracy, Calif. Injector steam pipe spanner nut blew off, due to coupling nut being too large for injector fit; 1 killed.

December 16, 1919, locomotive 2402, Pittsburg, Calif. Superheater tube broke where welded to back flue sheet; defective and improper weld; 2 injured.

January 3, 1920, locomotive 1787, Serrano, Calif. Injector steam pipe broke at throttle connection; 2 injured.

January 14, 1920, locomotive 2660, Mountain View, Calif. Injector heater valve bonnet removed for purpose of injecting sawdust into boiler; attempted to operate injector without replacing bonnet; 1 injured.

February 2, 1920, locomotive 2230, Tracy, Calif. Acetylene headlight exploded; 1 injured.

February 20, 1920, locomotive 1125, San Francisco, Calif. Right front spring hanger broke, allowing front end of engine to drop down, and causing foot-board to strike rail and double back under engine; flaw in spring hanger; 1 injured.

March 2, 1920, locomotive 2144, Stockton, Calif. Acetylene headlight exploded; 1 injured.

March 7, 1920, locomotive 2554, Dona, N. Mex. Squirt hose parted at splice; hose insecurely clamped; 1 injured.

June 20, 1920, locomotive 1676, Brawley, Calif. Squirt hose blew off; hose insecurely applied; 1 injured.

Fifteen accidents; 1 killed, 17 injured.

SOUTHERN RAILROAD:

July 2, 1919, locomotive 4528, Birmingham, Ala. Squirt hose blew off; hose insecurely clamped; 1 injured.

July 13, 1919, locomotive 634, Milltown, Ind. Fireman struck by water cooler which fell off, due to being insecurely fastened; 1 injured.

July 24, 1919, locomotive 585, Saulsbury, Tenn. Shaker bar slipped off lever, due to improper fit of bar on lever; 1 injured.

July 29, 1919, locomotive 6250, High Bridge, Ky. Shaker bar slipped off lever; shaker bar socket too large for lever; 1 injured.

July 31, 1919, locomotive 456, Hodges, S. C. Squirt hose burst; defective hose; 1 injured.

August 6, 1919, locomotive 4616, Inman Yards, Ga. Air attachment which had been applied to assist in handling reverse lever was defective and caused reverse lever to fly with force; 1 injured.

August 11, 1919, locomotive 32, Forest City, N. C. Squirt hose valve bonnet blew off; 1 injured.

August 23, 1919, locomotive 339, Dalton, Ga. Squirt hose blew off; hose insecurely clamped; 1 injured.

August 28, 1919, locomotive 6226, Hillsdale, Miss. Injured while operating reverse lever, due to nut working off front counterbalance rod, allowing counter-

September 1, 1919, locomotive 3841, Mobile, Ala. Ash-pan blower valve cap blew off while attempting to tighten under pressure; 1 injured.

September 13, 1919, locomotive 270, Princeton, Ind. Injured while operating reverse lever, due to back-up eccentric blades striking frame cross brace; frame cross brace not properly fitted so as to clear back-up eccentric blades; 1 injured.

September 24, 1919, locomotive 6894, Ellisville, Miss. Glass fell out of cab ventilator, cutting engineer's hand; 1 injured.

October 8, 1919, locomotive 265, Liberty Hill, Tenn. Squirt hose blew off; hose not clamped; 1 injured.

October 10, 1919, locomotive 916, Princeton, Ind. Washout plug blew out; threads in washout hole defective and shoulder of graphite on plug; plug insecurely applied; 1 injured.

October 14, 1919, locomotive 674, Salvisa, Ky. Shaker bar slipped off lever, due to improper fit of bar on lever; 1 injured.

November 8, 1919, locomotive 4608, Iron City, Ala. Injured while operating reverse lever, due to foot being caught between lever and boilerhead; 1 injured.

November 21, 1919, locomotive 445, Piedmont, S. C. Squirt hose blew off; hose insecurely applied; work report for November 18 reported "Put on squirt hose"; repairs not made; 1 injured.

November 22, 1919, locomotive 204 (G. S. & F.), Macon, Ga. Driving spring hanger broke; 1 injured.

December 2, 1919, locomotive 1031, near Mount Vernon, Ill. Injured while operating shaker bar; insufficient clearance between shaker bar and oil tray; 1 injured.

December 8, 1919, locomotive 1879, Oakdale, Tenn. Injured while shaking grates, due to insufficient clearance between shaker bar and oil-can rack; 1 injured.

December 8, 1919, locomotive 790, Princeton, Ind. Injured while operating reverse lever; insufficient clearance between lever and gauge cock drip pipe; 1 injured.

December 13, 1919, locomotive 1288, Wilsons Mill, N. C. Injector steam pipe pulled out of collar; collar not properly brazed or secured on pipe; 1 injured.

December 21, 1919, locomotive 676, Memphis, Tenn. Squirt pipe broke off at connection to injector delivery pipe, due to defective L; 1 injured.

December 23, 1919, locomotive 4766, near Stearns, Ky. Steam grate shaker inoperative; while attempting to operate shaker bar by hand the bar slipped off lever, due to improper fit; 1 injured.

January 1, 1920, locomotive 1023, Atlanta, Ga. Injured while operating reverse lever; lever difficult to operate; 1 injured.

* January 2, 1920, locomotive 183, Hominy, N. C. Injured due to defective footboard on locomotive; 1 injured.

January 3, 1920, locomotive 6229, McNeil, Miss. Engineer's foot caught between piping on boilerhead and reverse lever, due to insufficient clearance; 1 injured.

January 11, 1920, locomotive 6910, Enterprise, Miss. Left back union link pin came out, permitting steam to be trapped in front end of cylinder, causing boiler head to be blown out; 1 injured.

January 15, 1920, locomotive 200, Macon, Ga. Ashpan lever bent; fireman's hand caught between lever and feed pipe, due to insufficient clearance; 1 injured.

January 18, 1920, locomotive 4622, Sanitorium, Ga. Injury due to firebox door breaking; 1 injured.

January 24, 1920, locomotive 6189, Tenbridge, Tenn. Shaker bar slipped off lever, due to improper fit; 1 injured.

* January 29, 1920, locomotive 6026, Cincinnati, Ohio. Shaker bar slipped off lever, due to improper fit of bar on lever; 1 injured.

January 29, 1920, locomotive 1022, Ashby, Ala. Shaker bar slipped off lever while fireman was shaking grates; 1 injured.

* February 3, 1920, locomotive 4564, Oglethorpe, Ga. Injured while shaking grates, due to shaker bar being too small for socket; 1 injured.

* February 6, 1920, locomotive 4598, Spartanburg, S. C. Engine and tender parted, due to drawbar breaking, causing fireman to fall between engine and tender; 1 injured.

February 11, 1920, locomotive 445, Bamberg, S. C. Injector steam pipe collar pulled off, due to being improperly brazed; 3 injured.

February 13, 1920, locomotive 6502, Meridian, Miss. Injured while operating shaker bar, due to cotter key coming out of connecting-rod pin; 1 injured.

February 14, 1920, locomotive 1021, near Chase, Ala. Injured while shaking grates, due to reach rod breaking; defective weld in reach rod; 1 injured.

* February 25, 1920, locomotive 5050, Asheville, N. C. Pilot of engine gave way, due to bolt being lost out, causing brakeman to fall; 1 injured.

March 3, 1920, locomotive 286, Anniston, Ala. Injured while operating shaker bar; bar improperly applied; insufficient clearance between shaker bar and boiler head; 1 injured.

* March 5, 1920, locomotive 4774, Revilo, Ky. Injured while shaking grates, due to shaker bar being of improper fit; 1 injured.

** March 16, 1920, locomotive 6465, Donerail, Ky. Injured while operating reverse lever, due to broken valve rings dropping into steam port; 1 injured.

** March 24, 1920, locomotive 5021, Roe Junction, Tenn. Arch tube pulled out of throat sheet, due to improper application; tube not properly beaded; 3 injured.

* April 8, 1920, locomotive 351, Pine Level, N. C. Grate rigging became disconnected; 1 injured.

April 21, 1920, locomotive 744, Connelly Springs, N. C. Cast iron T in injector delivery pipe broke; old crack in T; 1 injured.

* April 28, 1920, locomotive 4578, Gainesville, Ga. Injured while shaking grates, due to shaker bar being too small for socket; 1 injured.

April 30, 1920, locomotive 5006, Paint Rock, N. C. Crown sheet failure; low water; no contributory causes found; 1 injured.

May 3, 1920, locomotive 3419, Abbeville, S. C. Scalded by hot water from defective squirt hose pipe; 1 injured.

** May 7, 1920, locomotive 1509, Atlanta, Ga. Lubricator glass burst; cut by flying glass; guard removed at time of accident; 1 injured.

** May 8, 1920, locomotive 6254, near Donerail, Ky. Grate-shaker casting stud blew out of back boiler head; 1 injured.

May 8, 1920, locomotive 3438, Bristol, Va. Throttle-stem packing nut blew off while attempting to tighten with hammer and chisel; old crack in nut and nut badly mutilated due to use of hammer and chisel in tightening at previous times; 1 injured.

May 17, 1920, locomotive 647, Knoxville, Tenn. Air compressor steam valve bonnet blew off, due to threads on valve and threads on bonnet nut being of different pitch and defective; 1 injured.

* May 29, 1920, locomotive 786, Saluda, N. C. Main pin came out of driving rod on right side, causing reverse lever to come out of quadrant; 1 injured.

June 5, 1920, locomotive 1495, Oakdale, Tenn. Fell from ladder of engine, due to ladder being too short and rungs loose; 1 injured.

June 9, 1920, locomotive 6128, Corydon Junction, Ind. Reverse lever flew out of quadrant, due to bolts in reverse lever latch being loose; 1 injured.

June 16, 1920, locomotive 1227, Carbondale, Ga. Injector steam pipe parted at sleeve; sleeve improperly applied; 2 injured.

June 28, 1920, locomotive 676, Irvington, Ala. Squirt hose blew off; hose improperly clamped; 1 injured.

June 28, 1920, locomotive 5028, Bessmer City, N. C. Injector steam pipe broke at flange; 1 injured.

Fifty-eight accidents; 63 injured.

TERMINAL RAILROAD ASSOCIATION OF ST. LOUIS:

December 5, 1919, locomotive 112, Madison, Ill. Flue broke at weld; defective weld; 2 injured.

One accident; 2 injured.

TEXAS & PACIFIC RAILWAY:

* July 21, 1919, locomotive 600, Longview Junction, Tex. Pilot step on engine broke, causing brakeman to fall; 1 injured.

July 25, 1919, locomotive 556 (U. S.), near Millsap, Tex. Crown sheet failure; low water; opening in right bottom water glass cock reduced to one-eighth inch, and opening in left bottom water glass cock reduced to three-sixteenth inch, due to scale formation; bottom of right water glass partially stopped up with asbestos gasket. Crown sheet of combustion chamber was autogenously welded to crown sheet of fire box; this weld failed for a distance of 56 inches; 2 killed.

September 6, 1919, locomotive 197, Addis, La. Injured while operating reverse lever. With brake valve handle in release position there was no clearance between handle and reverse lever, when lever was in forward position; 1 injured.

October 10, 1919, locomotive 125, Harmon, La. Headlight case fell off due to nuts missing from bolts securing headlight case in place; 1 injured.

October 22, 1919, locomotive 128, Westwego, La. Crown sheet failure; low water; top opening of water glass closed by rubber gasket; bottom water glass cock found closed at time of investigation; middle gauge cock stuck shut; work report for October 15 shows the following: "Put in new water glass; water glass bad"; 1 injured.

November 3, 1919, locomotive 140, Alexandria, La. Injured while operating reverse lever, due to improper application of foot brace; 1 injured.

November 5, 1919, locomotive 315, Marthaville, La. Crown sheet failure; low water; no contributory causes found; 2 injured.

November 23, 1919, locomotive 809, Fort Worth, Tex. Arch tube washout plug blew out; attempted to tighten under pressure; 2 injured.

January 10, 1920, locomotive 468 (U. S.), Fort Worth, Tex. Bottom section of right sand pipe came loose and dropped down, while locomotive was running backwards, catching footboard and bending brackets; 1 injured.

* January 31, 1920, locomotive 306, Jonesville, Tex. Left side rod broke; 1 injured.

February 16, 1920, locomotive 20, Natchitoches, La. Crown sheet failure; low water; no contributory causes found; 1 killed.

March 9, 1920, locomotive 171, near Addis, La. Safety key in front end of ashpan slide reach rod worked out, permitting front end of rod to drop and catch on roadbed; 1 injured.

March 9, 1920, locomotive 134, Shreveport, La. Bottom end of front vertical post of hand rail on top of tender pulled out of flanged socket; 1 injured.

** April 5, 1920, locomotive 353, Palmetto, La. Bolt worked out of front end of firing valve rigging reach rod, permitting rod to drop; 1 injured.

April 16, 1920, locomotive 354, Fort Worth, Tex. Washout plug blew out; attempted to tighten under pressure; plug cross-threaded; 1 injured.

May 8, 1920; locomotive 251, Torras, La. Squirt hose burst; defective hose; 1 injured.

May 13, 1920, locomotive 9450 (M. P.), Gouldsboro, La. Squirt hose burst; defective hose; 1 injured.

May 26, 1920, locomotive 509, Lodi, Tex. Scalded by hot water from squirt hose; hose badly worn; 1 injured.

June 16, 1920, locomotive 289, Melville, La. Stem blew out of bottom water-glass cock; no means provided to prevent stem from being entirely screwed out; 1 injured.

Nineteen accidents; 3 killed, 19 injured.

TOLEDO & OHIO CENTRAL RAILWAY:

December 26, 1919, locomotive 9636, Fultonham, Ohio. Washout cap blew out; attempted to tighten under pressure; cap not securely tightened when applied, due to excessive use of gaskets; 1 injured.

One accident; 1 injured.

UNION PACIFIC RAILROAD:

July 21, 1919, locomotive 5008, near Curvo, Utah. Crown sheet failure; low water; no contributory causes found; the door and flue sheet seams, as well as the seam connecting crown sheet of combustion chamber to crown sheet of fire box, were autogenously welded; the welded seam at combustion chamber failed completely; 3 killed.

July 26, 1919, locomotive 134, Armstrong, Kans. Washout plug blew out; threads on plug stripped; 4 injured.

** November 9, 1919, locomotive 308, Big Springs, Nebr. Squirt pipe broke; 1 injured.

April 2, 1920, locomotive 4329, Denver, Colo. Ashpan blower pipe pulled out of union connection; threads on pipe practically wasted away, and threads in union partially stripped; 1 killed.

Four accidents; 4 killed, 5 injured.

VIRGINIA RAILWAY:

July 6, 1919, locomotive 516, near Yellow Sulphur, Va. Flue broke at butt weld; defective weld; 1 injured.

* April 19, 1920, locomotive 712, Shelby, Va. Injured while shaking grates, due to clamp slipping off; 1 injured.

Two accidents; 2 injured.

WABASH RAILWAY:

* July 16, 1919, locomotive 2071, Wabash, Ind. Drawbar between locomotive and tender pulled out; 1 injured.

August 20, 1919, locomotive 264, Council Bluffs, Iowa. Blow-off cock leaking; scalded by hot water emitting from extension pipe; 1 injured.

September 13, 1919, locomotive 668, Boody, Ill. Injured while operating reverse lever, due to bolt holding connection link between lower end of reverse lever and air valve coming out; 1 injured.

September 18, 1919, locomotive 509, St. Louis, Mo. Side rod broke at main connection, causing locomotive to be derailed and fall from Mississippi River Bridge; attempt had been made to repair old crack in rod by welding a reinforcement on boss at bottom of rod; cross-sectional area of the rod had been reduced by boring out nine-sixteenth inch larger than original diameter; 2 killed.

* October 19, 1919, locomotive 670, Blue Mound, Ill. Shaker bar slipped off lever; 1 injured.

January 3, 1920, locomotive 2164, near Wilcox, Mo. Injured while operating reverse lever, due to counterbalance spring rod bolt breaking; old fracture in bolt, and material in bolt crystallized; 1 injured.

January 14, 1920, locomotive 893, Macon, Mo. Shaker bar broke at weld while shaking grates; defective weld; 2 injured.

* June 5, 1920, locomotive 2084, Munson, Mich. Squirt hose became disconnected; 1 injured.

June 18, 1920, locomotive 642, Silver City, Iowa. Locomotive derailed and overturned, caused by second pair of engine truck wheels having loose wheel on axle, due to improper fit; bore of wheel measured larger than wheel fit; 1 killed, 1 injured.

Nine accidents; 3 killed, 9 injured.

WESTERN MARYLAND RAILWAY:

January 1, 1920, locomotive 509, Clear Spring, Md. Crown-sheet failure; low water; appurtenances destroyed and disturbed to such extent that their previous condition could not be determined; 3 killed, 4 injured.

* March 14, 1920, locomotive 785, Buena Vista, Md. Strip on cab to keep rain out of window gave way, causing brakeman to fall; 1 injured.

Two accidents; 3 killed, 5 injured.

WESTERN PACIFIC RAILROAD:

March 13, 1920, locomotive 3, Wendover, Utah. Broken crown stay blew out while attempting to calk with 150 pounds pressure in boiler; threads on crown stay practically corroded away; crown stay hole had poor threads on one side, while on opposite side threads were completely wasted away; examination disclosed 17 additional crown stays broken and six with old fractures; 20 stays recently applied had short heads; crown stays reported leaking on March 8, 9, and 12; 2 killed.

One accident; 2 killed.

WHEELING & LAKE ERIE RAILWAY:

* May 5, 1920, locomotive 2205, Sugar Creek, Ohio. Injured while shaking grates, due to pin missing from grate shaker rod; 1 injured.

One accident, 1 injured.

WICHITA VALLEY RAILWAY:

* November 14, 1919, locomotive 13, Anson, Tex. Locomotive moved while making repairs to brake rigging, due to throttle defective and leaking; 1 killed.

One accident; 1 killed.

YAZOO & MISSISSIPPI VALLEY RAILROAD:

* August 7, 1919, locomotive 838 (I. C.), Nonconnah, Tenn. Water glass burst; one glass missing from water glass shield; cut by flying glass; 1 injured.

* August 29, 1919, locomotive 944 (I. C.), Greenwood, Miss. Bolt came out of shaker bar while shaking grates; 1 injured.

October 23, 1919, locomotive 2035 (I. C.), Vicksburg, Miss. Injector delivery pipe spanner nut broke; nut split, due to use of hammer and chisel in tightening; 1 injured.

May 1, 1920, locomotive 452 (I. C.), Vicksburg, Miss. Flue broke at weld, due to material being reduced in thickness to $\frac{1}{2}$ inch and $\frac{1}{8}$ inch, where safe end was welded to flue; 1 injured.

Four accidents; 4 injured.