



October 1934

BALDWIN LOCOMOTIVES

Steam Meets the Challenge

BY MALCOLM K. WRIGHT



ON FRIDAY, July 20, 1934, the regular 9 a. m. express from Chicago to Milwaukee, on the Chicago, Milwaukee, St. Paul and Pacific Railroad, smashed the world's record for sustained steam train speed by traveling more than 68 miles at an average speed of almost 90 miles per hour.

Not only is this a record for steam trains but exceeds all average railroad speeds for the distance made in regular service and under normal operating conditions.

It was the psychological moment for the steam locomotive to break into the railroad speed picture once more. For more than a year the subject of passenger train speed had occupied the mind of the public probably as never before. Newspapers, magazines and newsreels had featured the new internal-combustion powered streamlined trains already built or planned. Predictions were freely made that this new type of power was the only answer to the demand for speedy railroad transportation.

Record Run Dramatic Reminder

The record run of the Milwaukee train was a dramatic reminder that the modern steam locomotive was capable of high sustained speeds with a train weighing more than four times as much as any existing internal-combustion train, and capable of seating two or three times as many passengers.

It is significant that the record was not made with specially built or prepared equipment, but with a regular express which runs daily from Chicago to Milwaukee. The scheduled time for the 85.7-mile run is 90 minutes but on this occasion the train was speeded up so that the time was reduced to 67 minutes 35 seconds. This gives an average start-to-stop speed of 76.07 miles per hour.

This average for the total distance compares favorably with the best previous steam locomotive performance in spite of the fact that the first five miles out of Chicago and the last mile into Milwaukee were made at comparatively slow speeds.

Passengers Unaware of Record Run

Most of the passengers were unaware of the fact that a record run was being attempted until the train passed Pacific Junction about five miles from the Chicago terminal. Here the engineer opened the throttle wider and the flying landscape soon made it evident to the most casual observer that this was no ordinary speed. The camera men, however, had been prepared beforehand, and soon the entire country was able to share the thrill of this record run through the medium of the pictures which appeared in the newsreels and the accounts in the daily papers.

It was between Mayfair (nine miles out of Chicago) and Lake, a total distance of 68.9 miles, that the train broke all existing steam-train records for the distance with an average speed of 89.92 miles per hour. This is almost nine miles per hour faster than the best previous record for a run of similar length, held by the Great Western Railway of England.

On June 6, 1932, this British road made a test run from Swindon to Paddington (London), a distance of 77.3 miles at an average speed of 81.6 miles per hour. This was a world's record at that time and stood unchallenged until surpassed by the Milwaukee.

The following tabulation shows some of the average speeds made during the Chicago to Milwaukee run and undoubtedly most if not all of these, establish new records for their respective distances.

Stations	Distance in miles	Time	Average speed M. P. H.
Chicago to Milwaukee..	85.7	67 min. 35 sec.	76.07
Mayfair to Lake	68.9	45 min. 58 sec.	89.92
Edgebrook to Oakwood	61.4	39 min. 46 sec.	92.62
Caledonia to Oakwood..	3.38	2 min. 4 sec.	97.97
Gurnee to Wadsworth..	4.18	2 min. 34 sec.	97.44

On this page is given the official log of the trip showing the time at which the train passed each station, the distances traversed and the average speeds between stations. The highest speed registered by the speedometer during the entire run was 103.5 miles per hour at Oakwood.

The five-car train was made up as follows:

Engine	6402	326.8 tons
Baggage car	1042	72.0 tons
Coach	4283	80.0 tons
Coach	4000	76.5 tons
Parlor car	Columbia	87.8 tons
Business car	Wisconsin	92.5 tons

Total 735.6 tons

The total weight back of the tender was about 408 tons. If the train had been made up with ordinary 80 ton coaches in place of the parlor and business cars, it would have provided seats for approximately 250 passengers.

The profile of the line between Chicago and Milwaukee is fairly level and the steepest grade against the load was not over 0.6%. The steepest grade in favor of the load was 0.67%. The curves are not any sharper than 1° at any point on this line except near the terminals where train speeds are low.

The locomotive which bears the proud distinction of having made this bit of railroad history was number 6402, Milwaukee class F-6, one of fourteen similar locomotives built by The Baldwin Locomotive Works in 1929.

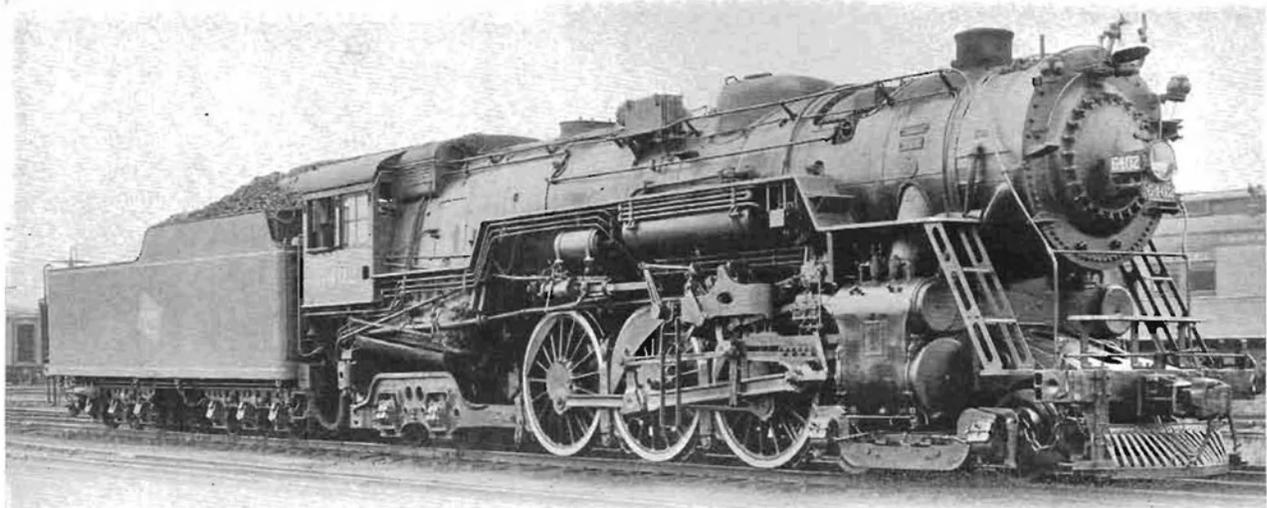
It was no special machine constructed for a speed test, but simply a good modern locomotive with a background of more than four years

of routine work well done. However, this was not the first distinction enjoyed by number 6402. It is one of 22 locomotives (Classes F-6 and F-6a) which established a notable mileage record of 10,399 miles per month for each locomotive over a period of years. (*Baldwin Locomotives*, April-July, 1934.)

The following tabulation gives the principal

Stations	Time Passing Stations			Distance Miles From Chicago Official Time	Distance Increment Miles	Time Increment		Speed Between Stations M.P.H.
	Hr.	Min.	Sec.			Min.	Sec.	
Chicago.....	8	59	55	.0	.0	0	0	...
Western Ave....	9	06	30	2.9	2.9	6	35	26.4
Pacific Jct.....	9	09	32	5.4	2.5	3	02	49.3
Healy.....	9	10	23	6.4	1.0	0	51	69.9
Grayland.....	9	11	56	8.2	1.8	1	33	69.15
Mayfair.....	9	12	45	9.0	0.8	0	49	58.0
Forest Glen....	9	13	53	10.2	1.2	1	08	63.0
Edgebrook.....	9	15	45	12.3	2.1	1	52	67.0
Morton Grove..	9	17	05	14.3	2.0	1	20	89.6
Golf.....	9	18	16	16.2	1.9	1	11	96.0
Glenview.....	9	19	06	17.4	1.2	0	50	96.6
Techny.....	9	21	12	20.2	2.8	2	06	80.0
Northbrook....	9	21	43	20.9	0.7	0	31	80.3
Deerfield.....	9	23	48	23.9	3.0	2	05	86.4
W. Lake Forest.	9	26	24	28.0	4.1	2	36	94.4
Rondout.....	9	29	05	32.3	4.3	2	41	95.7
Wilson.....	9	32	03	36.8	4.5	2	58	90.0
Gurnee.....	9	33	17	38.6	1.8	1	14	86.8
Wadsworth....	9	35	51	42.9	4.18	2	34	97.44
Russell.....	9	38	30	47.0	4.1	2	39	94.5
Ranney.....	9	41	27	51.6	4.6	2	57	93.2
Truesdell....	9	42	12	52.6	1.0	0	45	79.2
Somers.....	9	45	30	57.5	4.9	3	18	88.8
Sturtevant....	9	48	28	61.8	4.3	2	58	86.5
Franksville....	9	51	14	66.0	4.2	2	46	90.8
Caledonia....	9	53	27	69.4	3.4	2	13	91.8
Oakwood.....	9	55	31	72.8	3.38	2	04	97.97
Lake.....	9	58	43	77.9	5.1	3	12	95.5
National Ave...	10	04	41	84.1	6.2	5	58	62.1
Milwaukee.....	10	07	30	85.0	0.9	2	49	19.0

Official Log of the run made by Locomotive 6402 from Chicago to Milwaukee.



Milwaukee, St. Paul and Pacific Locomotive Number 6402, which broke the world's record for sustained steam train speed by hauling a five-car train 68.9 miles at an average speed of 89.92 miles per hour.

dimensions of Milwaukee class F-6 locomotive number 6402:

Locomotive type	4-6-4
Cylinders26" x 28"
Valves	14" piston
Driving wheels, diameter.....	.80" over 4" tires
Steam pressure	225 lb.
Tubes58—2 $\frac{1}{4}$ "
Superheater flues.....	182—3 $\frac{1}{2}$ "
Grate area.....	.80 sq. ft.
Total heating surface (evaporating) ..	4205 sq. ft.
Weight on drivers	189,720 lb.
Weight on trailing truck	106,200 lb.
Weight on leading truck	79,930 lb.
Total weight in working order.....	375,850 lb.
Weight of tender	277,800 lb.
Weight of engine and tender	653,650 lb.
Tractive effort	45,822 lb.
Factor of adhesion.....	4.14
Tender water capacity.....	15,000 gal.
Tender coal capacity	20 tons

No record was made of the exact amount of coal and water used during the Milwaukee run, but the best estimate of the locomotive crew is 6200 gallons of water, and four tons of coal. This gives an evaporation rate of approximately 6.45 pounds of water per pound of coal, which is a creditable performance at these high speeds.

Indiana coal was used, the average analysis of which was as follows:

Moisture	10.09%
Volatile matter.....	37.85%
Fixed carbon	41.29%
Ash	10.77%
Sulphur	3.33%
B. T. U.....	11,112

Internal Combustion Records

What about the internal - combustion powered trains? How does their performance compare with this record made by the Milwaukee steam train?

At the time of writing, the Union Pacific streamlined train and the Burlington "Zephyr" had not been placed in actual service. However, it is interesting to compare the Milwaukee run with the few test runs made by these units, and also with the "Flying Hamburger"

which is operating in regular service in Germany. The Union Pacific, three-car train, completed in February, 1934, is made of aluminum alloys and has a total weight of about 85 tons. In addition to mail and baggage compartments, the train seats 116 passengers. It is powered with one 600 horse-power, 12-cylinder, distillate-burning engine. This train was designed for a balanced speed of 90 miles per hour on tangent level track, and a maximum speed of 110 miles per hour.

No records of high sustained speeds made by this train are available, but in a special test run it reached a maximum speed of 111 miles per hour. The Burlington "Zephyr" is a three-car train of stainless steel, and weighs about 97.5 tons. In addition to baggage and mail compartments, it provides seats for 72 passengers. Power is supplied by one 600 horse-power Diesel engine. On May 26, 1934, the "Zephyr" made a non-stop run from Denver to Chicago, a distance of 1,015.4 miles in 13 hours, 5 minutes. This gives an average speed of 77.5 miles per hour for the entire distance.

This was purely a test run for which careful preparation had been made. The profile of the line and the curve elevations were checked, and speed charts prepared to show the permissible rates of speed all along the line. Two flagmen were stationed at each of 1,070 public grade crossings and one flagman at each of 619 private grade crossings. Special signal and maintenance men were used all along the line, and arrangements made with other railroads to assure safe continuous passage through all junction points.

The maximum speed registered by the "Zephyr" during this run was 112.5 miles per hour. The tabulation below gives some of the notable average speeds made during the test:



The Train Crew which made the Record Run is congratulated by Norman A. Ryan, Assistant General Manager of the Milwaukee. Reading from left to right, those in the picture are Frank Peterson, Brakeman; C. E. Albright, Conductor; Peter Mick, Brakeman; Ward B. Kirby, Fireman; William H. Dempsey, Engineer, and Mr. Ryan.

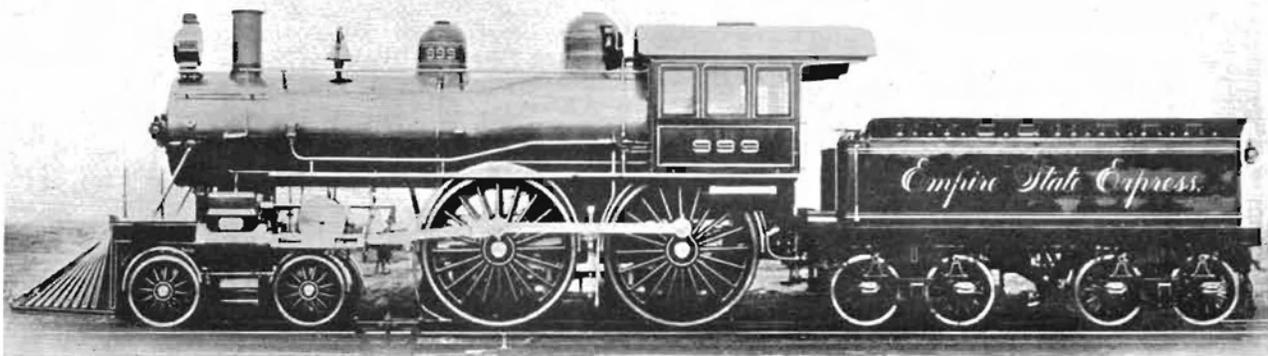
Stations	Distance in miles	Average speed M. P. H.
Yuma, Colo., to Schramm.....	6.4	109.0
Otis, Colo., to Schramm.....	19.1	104.4
Otis, Colo., to McCook, Neb.	129.5	90.0

All records for average speed for distances of 200 miles and over were broken during this dawn-to-dusk trip from Denver to Chicago.

Considered simply as a non-stop run, the "Zephyr" performance exceeded by two and one-half times the best steam record of 401 miles held by the "Royal Scot" trains of the London, Midland and Scottish Railway.

lar value at these higher speeds. Of even greater importance is the fact that the load hauled back of the tender was more than four times the weight of the entire light-weight unit. There is little doubt that if the steam train had consisted of cars of light steel or alloys, and had been given the advantage of streamlining, it could have exceeded the average speed of the "Zephyr" over any reasonable distance.

In addition, the steam train was in regular service running under normal operating conditions, whereas, the high speeds shown by the



New York Central Locomotive Number 999 which is reputed to have hauled the Empire State Express one mile at the rate of 112.5 miles per hour on May 11, 1893

Let us compare some of the average speeds made by the "Zephyr" with those made by the Milwaukee steam train.

Taking figures from the data previously given we find that the Milwaukee steam train traveled 3.38 miles at an average speed of 97.97 miles per hour. Against this the "Zephyr" traveled 6.4 miles at the rate of 109.0 miles per hour.

The steam train made 68.9 miles at 89.92 miles per hour, whereas, the "Zephyr" traveled 129.5 miles at the rate of 90.0 miles per hour.

It is hard to get a direct comparison, but these figures indicate that the average speed of the "Zephyr" for the best 70 miles of its run was slightly higher than the average shown for the steam train.

Steam Locomotive and Train Not Streamlined

It must be remembered, however, that the steam locomotive and train did not have the advantage of streamlining which is of particu-

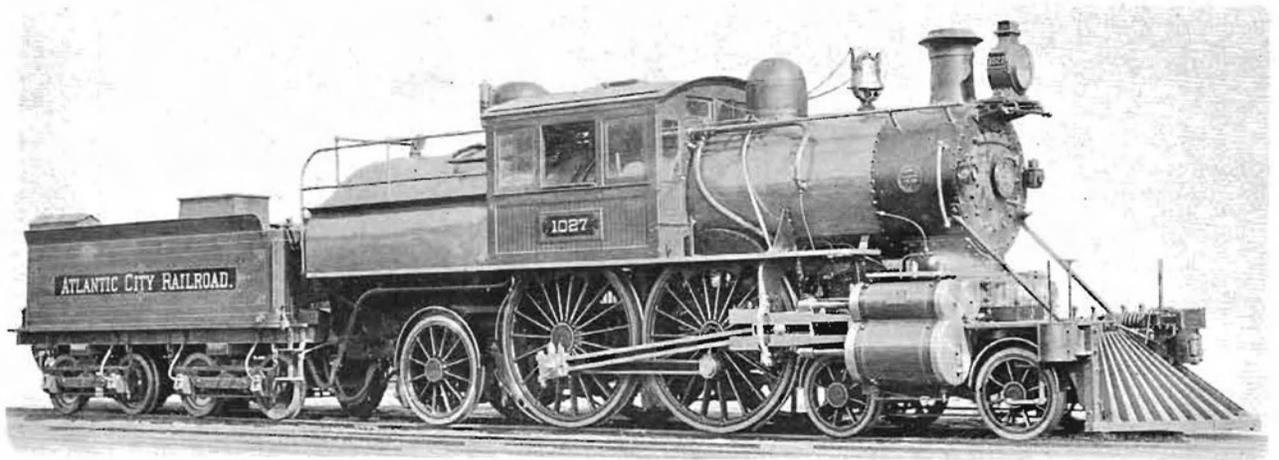
"Zephyr" were made under very special test conditions.

Outside of the United States, the only notable high speed, internal-combustion train is the "Flying Hamburger" of the German State Railways. It is an articulated unit consisting of two coach bodies carried on three trucks. Its total weight is about 85 tons in addition to which it carries 100 passengers.

This train was designed for a maximum speed of 99 miles per hour as compared with a maximum of about 110 miles per hour for the American units mentioned.

For more than a year, the German train has operated a regular schedule between Hamburg and Berlin, making the run of 179.2 miles at an average speed between 75 and 78 miles per hour for the entire distance.

This average speed is far below that of the "Zephyr" for an equal distance. It is also far below the average speed of the Milwaukee steam train but, of course, the distance trav-



Vaucrain Compound Locomotive which made a notable record for consistent high-speed operation between Camden and Atlantic City in the summer of 1897.

eled by the "Flying Hamburger" is more than twice the length of the Milwaukee run.

Early Steam Train Records

High speed is no new thing for the steam locomotive. Without in any way detracting from the Milwaukee run, which exceeded all previous efforts, it is interesting to examine some of the earlier speed performances of steam locomotives.

We have already mentioned the previous world's record held by the Great Western Railway of England, 77.3 miles at an average speed of 81.6 miles per hour.

The *Railroad Gazette* of May 12, 1893, gives some interesting figures on the speeds attained by New York Central and Hudson River locomotive number 999 hauling the *Empire State Express* between New York and Buffalo. During the run made on May 9, 1893, the five miles from Looneyville to Grimesville were traversed in 3½ minutes, an average speed of 86 miles per hour. One mile west of Grimesville was run in 35 seconds, giving an average speed of 102.8 miles per hour.

In the issue of May 19, 1893, the same paper reported as follows:

"The New York Central's Class N engine, No. 999, whose record of 102.8 miles an hour we published last week, broke that before the Railroad Gazette was off the press, and it is now claimed that the same runner, Mr. Hogan, hauling the same train, traversed a mile on May 11 in 32 seconds, equal to 112.5 miles an hour."

Claims of even higher speeds have been made for steam locomotives, but, like the above record of 112.5 miles per hour, they were for only a single mile and could not be classed as sustained speeds.

On April 12, 1897, the *Black Diamond* express on the Lehigh Valley ran from Alpine to Geneva Junction, a distance of 44 miles, at the rate of 80 miles per hour. This run was made with a five-car train, weighing 205 tons exclusive of engine and tender.

In the summer of 1897, the Philadelphia & Reading Railway established a notable record for consistent high-speed operation on the 55½ mile non-stop run from Camden to Atlantic City. For fifty-two days, from July 2nd to August 31st, 1897, the average time consumed on the run with Train No. 25 was 48 minutes, an average rate of speed from start to stop of 69 miles per hour. The train consisted of five or six cars with a total weight of about 200 tons.

During this entire period, Train No. 25 was hauled by Vaucrain Compound locomotive number 1027, which had been built by The Baldwin Locomotive Works in 1896.

On July 20, 1904 (30 years to a day before the recent Milwaukee run) a train on the Atlantic City Railroad of the Philadelphia and Reading made the run of 55.5 miles from Camden to Atlantic City in 43 minutes, an average speed of 77.4 miles per hour. From Winslow junction to Meadow Tower this train ran 29.3

miles at an average speed of 87.9 miles per hour.

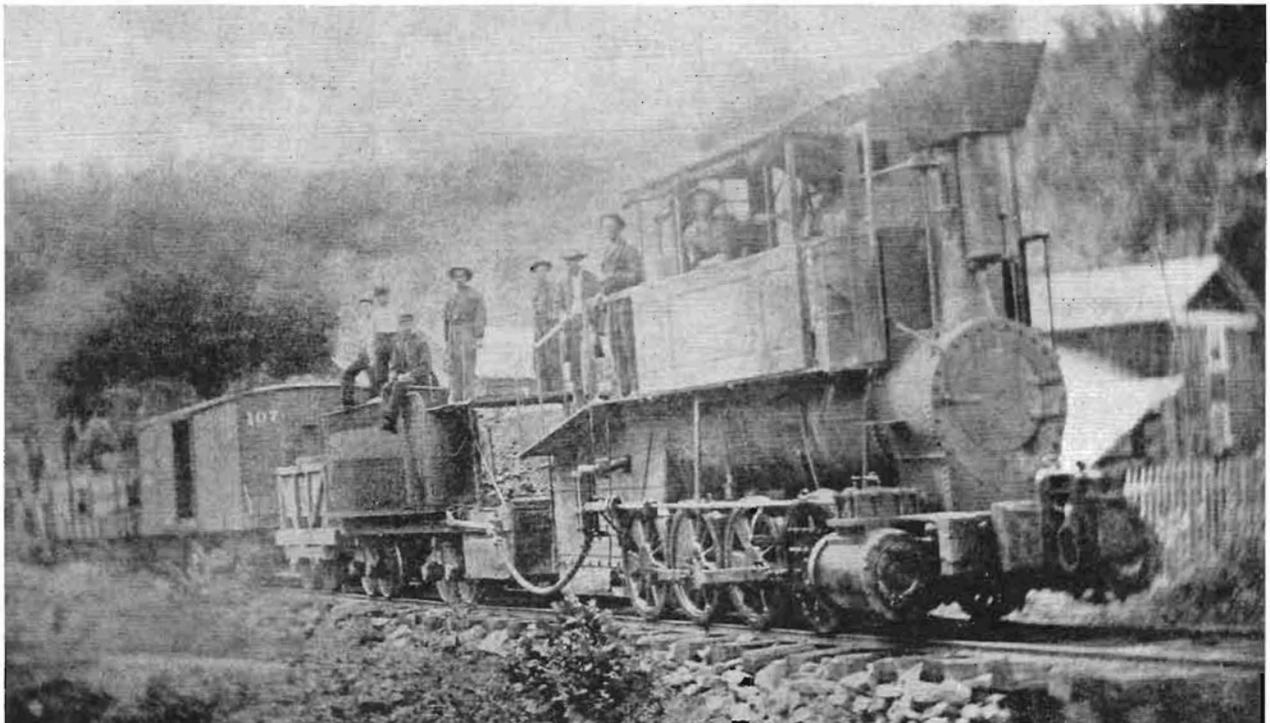
On June 8, 1905, a special Chicago-Pittsburgh train of three cars on the Pittsburgh, Fort Wayne and Chicago (now a part of the Pennsylvania System) ran 200 miles at the rate of 71.3 miles per hour. It made 100 miles of this distance at an average speed of 77.2 miles per hour and 50 miles at the rate of 79 miles per hour.

These are a few of the notable records made by steam locomotives hauling regular equipment. They are sufficient to demonstrate that there is nothing inherent in the steam locomotive to prevent running it at speeds which will

compare favorably with the speeds made by any other form of railroad motive power.

What has not yet been recorded, but which we believe the near future will show, is the high speed performance of which the steam locomotive is capable when cars of light weight material are substituted for conventional equipment, and the steam train is given the additional advantage of streamlining. It will be interesting to watch the results obtained by the Baltimore and Ohio Railroad with their high-speed 4-4-4 type steam locomotive and light-weight cars which are now being constructed.

A Locomotive of Seventy Years Ago



The TUSCARORA, Engine Number 1 on the Huntingdon and Broad Top Mountain Railroad. This CAMEL locomotive, built by Ross Winans of Baltimore, was in service on the Broad Top during the 60's. The boiler exploded at Coaldale, Pa., on September 11, 1868, killing four men. The illustration is from a photograph taken shortly before that date. The locomotive was repaired, but nothing is known of its subsequent history except that it disappeared from the Broad Top about 1870.