

10-WHEEL (4-6-0 TYPE) BALANCED COMPOUND LOCOMOTIVE—NASHVILLE, CHATTANOOGA AND ST. LOUIS RAILROAD.

eter, are set at 3-in. centers. This permits 256 of them to be placed in the boiler shell. A steam pressure of 210 lbs. is used.

Reference to the table of proportions of this locomotive will show that, as compared with a simple engine of the same power, it would be considered that the cylinders were somewhat large for the boiler capacity, but, inasmuch, as the balanced compound feature is used and the cylinder power is divided more evenly, this will probably not prove to be the case the B D factor (tractive effort  $\times$  dia. drivers  $\div$  total heating surface\*) while somewhat above that employed in recent balanced compounds, still is not excessively large, and would indicate that the engine would do its best work at a medium speed.

The general dimensions, weights and ratios follow:

4—6—0 TYPE VAUCLAIN BALANCED COMPOUND PASSENGER LOCOMOTIVE, NASHVILLE, CHATTANOOGA AND ST. LOUIS RY.  
GENERAL DATA.

Gauge	4 ft. 8½ ins.
Fuel	Bituminous coal.
Tractive power	29,050 lbs.
Weight in working order	181,380 lbs.
Weight on drivers	133,920 lbs.
Weight on leading truck	47,460 lbs.
Weight of engine and tender in working order	280,000 lbs.
Wheel base, driving	12 ft.
Wheel base, total	26 ft.
Wheel base, engine and tender	55 ft. 2 ins.

\*American Engineer, Feb., 1903, p. 53.

### EXPERIMENTAL LOCOMOTIVES, PENNSYLVANIA RAILROAD.

The Pennsylvania Railroad holds a special position among American Railroads in respect to its readiness to undertake the careful testing of any new design or device which seems to have elements pertaining toward improved locomotive or car performances. The organization of the company is such that testing of this nature can be carried on in a careful and thorough manner and the results obtained can be accepted as accurate and reliable.

The latest evidence of this position is found in the purchase of eight new locomotives, two each of four different designs, each including some comparatively new feature or arrangement. In selecting the types, those chosen were ones designed and built by the locomotive builders, which are in regular service on other railroads and which, to a certain extent, have been tried out and developed. In fact, all untried features were avoided as far as possible. To this group should also be added the DeGlehn compound locomotive bought in 1904, and partially tested on the Pennsylvania testing plant at the St. Louis World's Fair. A complete illustrated description of that locomotive was given in the AMERICAN ENGINEER AND RAILROAD JOURNAL in June, 1904.

Of the four types of American design, three are passenger locomotives; two of which are balanced compound Atlantic type and one simple Prairie type with Walschaert valve gear,

RATIOS.	
Tractive weight $\div$ tractive effort	4.6
Tractive effort $\times$ diam. drivers $\div$ heating surface	702
Heating surface $\div$ grate area	78.5
Total weight $\div$ tractive effort	6.24
Tube H. S. $\div$ total H. S.	.932
Tube H. S. $\div$ firebox H. S.	18.8
Total H. S. $\div$ vol. both cylinders	308
Grate area $\div$ vol. both cylinders	8.92

CYLINDERS.	
Kind	Balanced compound.
Diameter and stroke	16 and 27 by 28 ins.
Vol. both cylinders, cu. ft.	8.9

VALVES.	
Kind	Piston.

WHEELS.	
Driving, diameter over tires	66 ins.
Driving, thickness of tires	3 ins.
Driving journals, main, diameter and length	10 by 10½ ins.
Driving journal, others	9 by 12 ins.
Engine truck wheels, diameter	30 ins.
Engine truck, Journals	5½ by 12 ins.

BOILER.	
Style	Wagon top.
Working pressure	210 lbs.
Outside diameter of first ring	64 ins.
Firebox, length and width	120 by 41½ ins.
Firebox plates, thickness	¾, 7-16 and 3/8 in.
Firebox, water space	4 and 3 ins.
Tubes, number and outside diameter	256 2¼ in.
Tubes, length	17 ft.
Heating surface, tubes	2,550 sq. ft.
Heating surface, firebox	185 sq. ft.
Heating surface, total	2,735 sq. ft.
Grate area	34.8 sq. ft.
Centre of boiler above rail	106 ins.

TENDER.	
Wheels, diameter	33 ins.
Journals, diameter and length	6 by 9 ins.
Water capacity	5,000 gals.

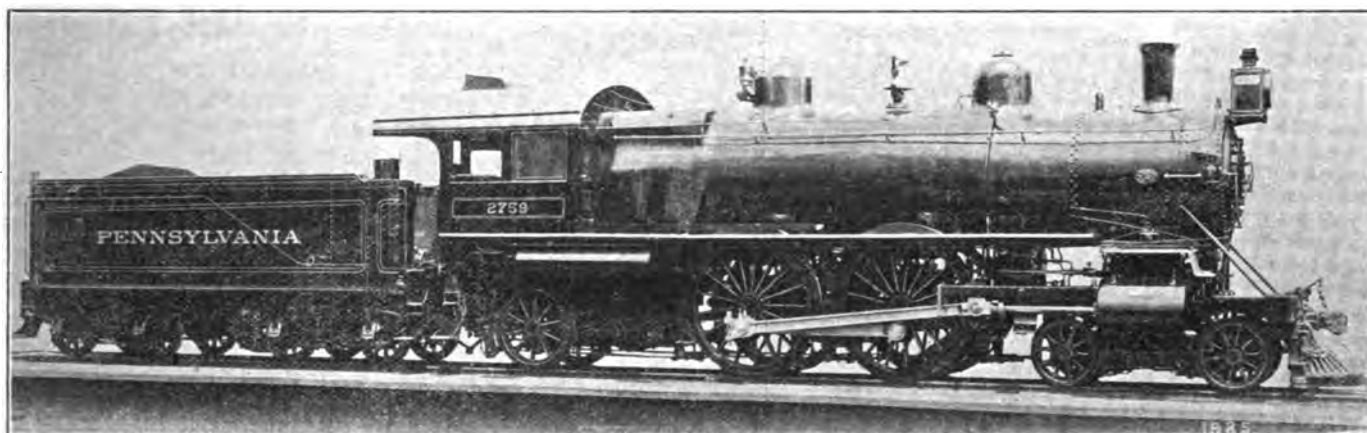
and the other is a large simple consolidation freight engine. These locomotives are now in regular service, one of each type on the lines east and one on the lines west of Pittsburgh, and complete reports of their performances, as compared with the standard locomotives of the company, are being taken.

It will be remembered that this company made a similar service test of different types of compound locomotives in 1896, all of the two-cylinder cross compound design. The group purchased at that time consisted of four mogul engines, the same in all respects except as to cylinders, which were also all of the same size, being 20 and 29 by 28 ins. There was one each using the Golsdorf, Von Borries, Pittsburg and Richmond designs for compounding. At that time the primary object of using steam in compound cylinders was for the purpose of saving fuel, and all of these locomotives proved to be a success in that respect, as compared with the simple engines of the same power, but for reasons connected with operation and cost of maintenance none of those types have proved to be a practical success under American conditions.

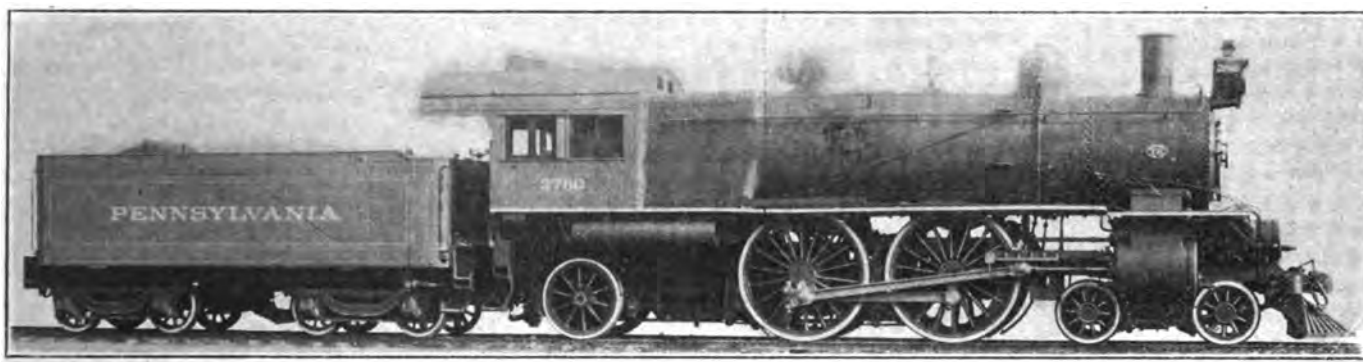
At the present time a successful system of compounding is sought with a different and much more vital point in view, having as its primary object the increasing of the hauling power and the sustained speed of the passenger locomotives, together with the but slightly secondary object of designing a machine which will operate at high speeds with less damage to itself and the track than is caused by the present designs

of high speed locomotives. The three different designs for these purposes, included in this group have, in one case from long foreign and in two cases from comparatively brief American experience, shown themselves to be very successful and the indications are that these types will not follow their predecessors into quick disuse.

The other passenger locomotive is of a type which, while new on the Pennsylvania Railroad, has been in long service on other American roads, the most notable previous example being the class J-41 engine of the Lake Shore & Michigan Southern Railway (AMERICAN ENGINEER, 1904, page 413), which has, up to this time, held the record as being the heaviest passenger locomotive ever built. The test on this engine



ATLANTIC (4-4-2) TYPE VAUCLAIN BALANCED COMPOUND LOCOMOTIVE—PENNSYLVANIA RAILROAD.



ATLANTIC (4-4-2) TYPE OOLE BALANCED COMPOUND LOCOMOTIVE—PENNSYLVANIA RAILROAD.

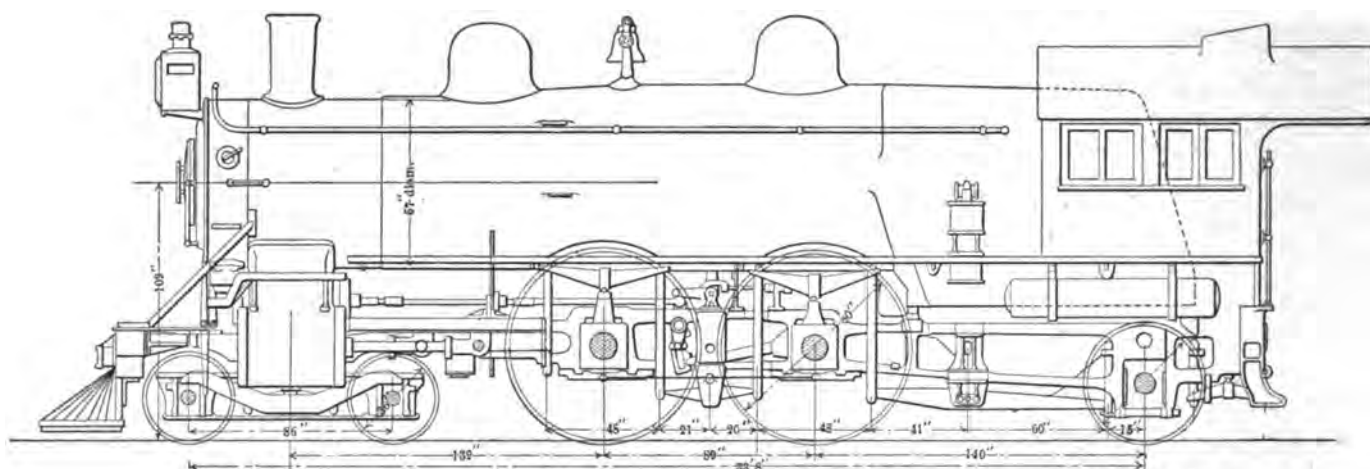


PRAIRIE (2-6-2) TYPE PASSENGER LOCOMOTIVE, WITH WALSCHAERT VALVE GEAR—PENNSYLVANIA RAILROAD.

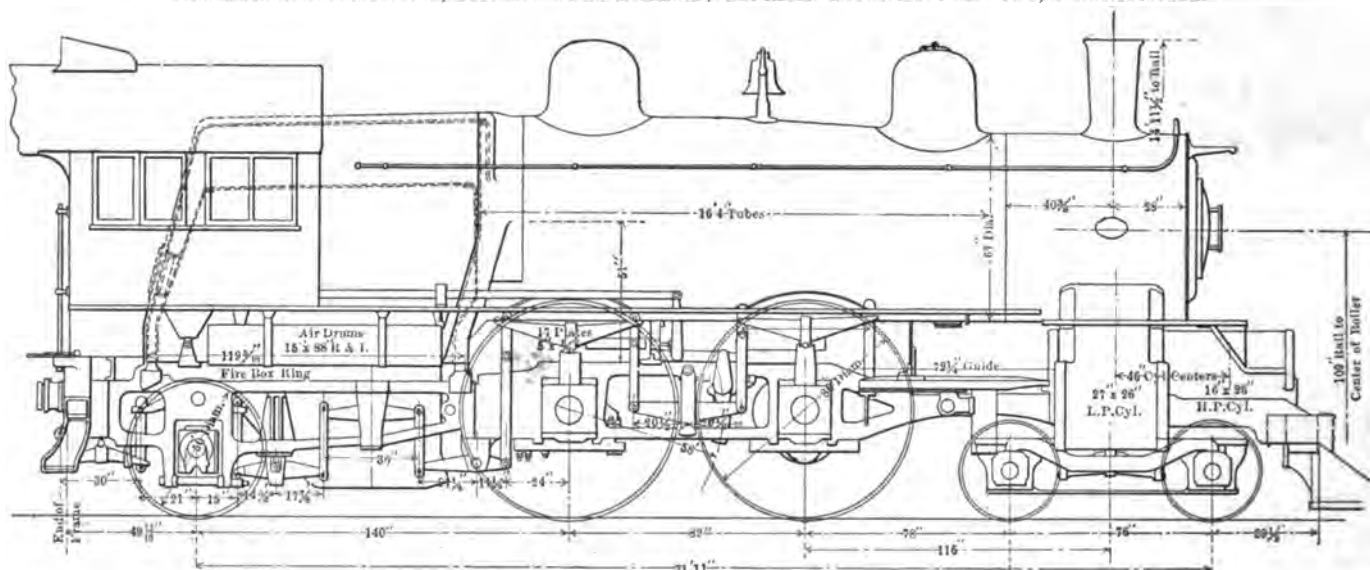


CONSOLIDATION (2-8-0 TYPE) FREIGHT LOCOMOTIVE—PENNSYLVANIA RAILROAD.

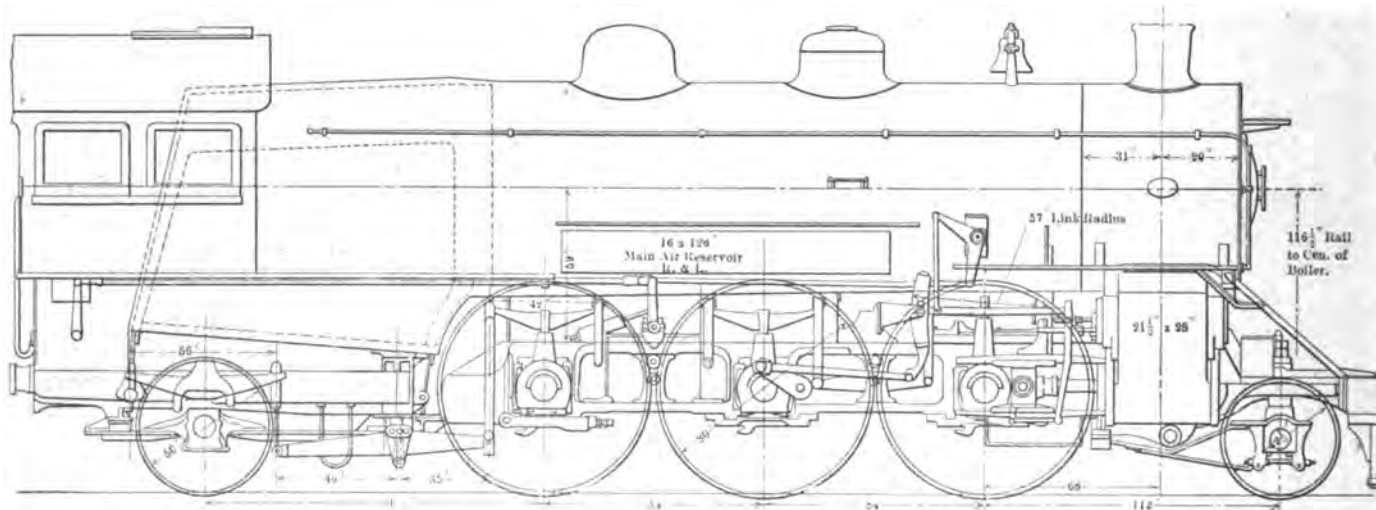
PENNSYLVANIA EXPERIMENTAL LOCOMOTIVES.



EXPERIMENTAL LOCOMOTIVE, PENNSYLVANIA RAILROAD, VAUCLAIN BALANCED COMPOUND, ATLANTIC TYPE.



EXPERIMENTAL LOCOMOTIVE, PENNSYLVANIA RAILROAD, COLE BALANCED COMPOUND, ATLANTIC TYPE.



EXPERIMENTAL LOCOMOTIVE, PENNSYLVANIA RAILROAD, PRAIRIE TYPE, WITH WALSCHAERT VALVE GEAR.

will be two-fold—the use of the two wheel leading truck on a line having many curves and the performance of the Walschaert valve gear on a high speed passenger locomotive.

The fifth locomotive of the group, a large consolidation freight engine, is simply a very powerful engine for heavy service, built from a straightforward strictly American design.

Referring to the particular locomotives comprising this group, the table of dimensions, together with the general views and outline diagrams herewith, will give a clear idea of each.

The DeGlehn compound engine, as above mentioned, has been thoroughly illustrated and described in these columns, and while being included in this group for experimental purposes is not illustrated herewith.

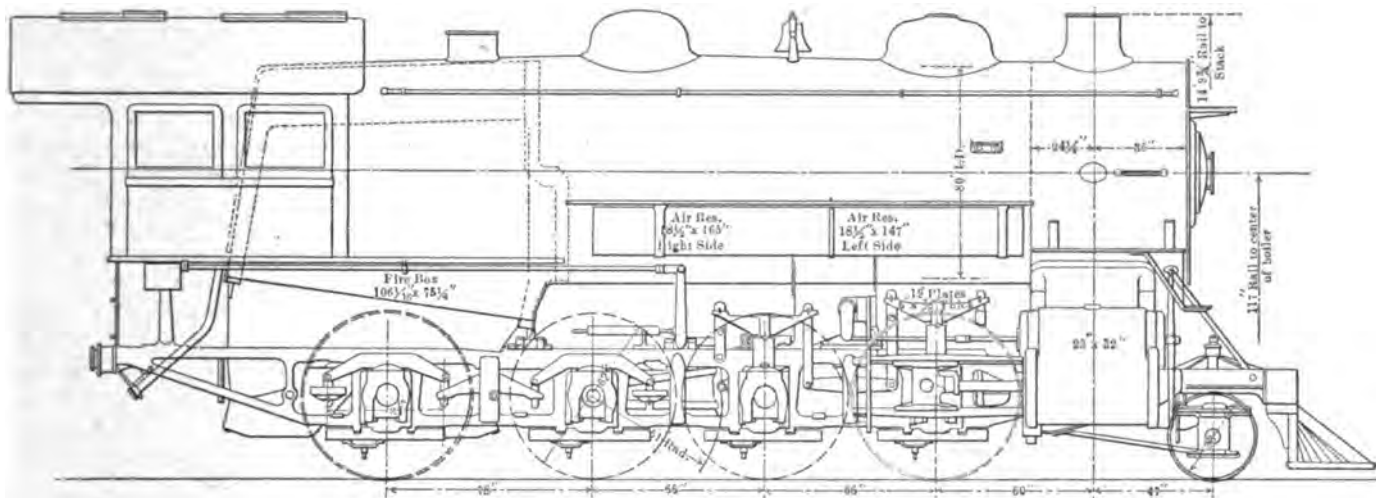
The Prairie type passenger locomotive is almost identical with the Lake Shore & Michigan Southern Railway engine mentioned above, it being 1,500 lbs. heavier in total weight and having 800 lbs. more weight on drivers. The cylinders are the same in both cases, being 21½ by 28 ins. The former locomotive has slightly more heating surface, due to a larger number of tubes in the boiler. The diameter of the drivers

in the latter engine being one inch larger gives it a slightly less theoretical tractive power, but in all other respects, excepting the valve gear, the two locomotives are practically identical.

The Walschaert valve gear here used has been described and illustrated in principle and detail in these columns many times during the past two years. The reports from examples already in use seem to be uniformly favorable, and the pres-

tive Company has 315—2-in. flues 16 ft. 4 ins. long, the heating surface in both cases being almost the same.

For details of the cylinder arrangement and connection of the Cole balanced compound reference can be made to the illustrated description of a similar locomotive for the New York Central & Hudson River Railroad (AMERICAN ENGINEER AND RAILROAD JOURNAL, June, 1904, page 241), and for the Baldwin balanced compound to a description of a similar



EXPERIMENTAL LOCOMOTIVE, PENNSYLVANIA RAILROAD, SIMPLE CONSOLIDATION.

Dimensions, Weights and Ratios of Experimental Locomotives, P. R. R.

Type	2-6-2	4-4-2	4-4-2	4-4-2	2-8-0
Road Numbers	2761	2769	2760	2512	2762
Builder	American	Baldwin	American	Soc. Ala.	American
Steam distribution	Simple	Bal. Comp.	Cole Comp.	De Glehn	Simple
Cylinder diameter, ins.	21 1/2	16 and 27	16 and 27	14.19 & 23.625	23
Stroke, ins.	28	28	28	25.19	32
Total weight, lbs.	234,500	195,900	200,500	164,000	220,000
Weight on drivers, lbs.	166,800	120,500	117,200	87,850	198,000
Diameter of drivers, lbs.	80	80	80	80.19	63
Valve	Piston	Piston	Piston	P & S	P
Valve gear (Walschaert or Stephenson)	W	S	S	W	S
Diameter of boiler	74 1/2 ins.	67 ins.	67 ins.	58 1/2 ins.	81 1/2 ins.
Length of flues	19 ft. 6 ins.	17 ft. 8 ins.	16 ft. 4 ins.	14 ft. 5 1/4 ins.	15 ft. 6 ins.
Diameter of flues	2 1/4 ins.	2 1/4 ins.	2 ins.	2 1/2 ins. †	2 ins.
Number of flues	322	261	315	139	446
Length of firebox	108 1-8 ins.	111 ins.	111 ins.	120 ins.	106 ins.
Width of firebox	73 1/4 ins.	72 ins.	72 ins.	39 3/4 ins.	75 1/4 ins.
Grate area, sq. ft.	55	55.5	55.5	33.9	55.4
Heating surface—flues, sq. ft.	3677.9	2698	2,680	2435.7	3598.5
Heating surface—firebox, sq. ft.	202.7	166	181.4	181.1	177.1
Heating surface—total, sq. ft.	3881.6	2864	2861.6	2616.8	3773.6
Height, centre boiler	9 ft. 8 1/2 ins.	9 ft. 1 in.	9 ft. 1 in.	8 ft. 10 5-16 in.	9 ft. 9 ins.
Steam pressure	200	205	205	227 1/2	200
Tender—water capacity	7000 gals.	5500 gals.	5500 gals.	5500 gals.	7000 gals.
Tender—coal capacity	10 tons.	12 1/4 tons	10 tons.	11 tons.	13 tons
Tender—weight loaded	139,300 lbs.	132,100 lbs.	125,300 lbs.	132,500 lbs.	140,500 lbs.
Vol. both cyl., cu. ft.*	11.76	8.9	8.9	7.15	15.4
Tractive effort	27,520	23,300	23,300	19,555	45,700
Ratio—Weight on drivers ÷ tractive effort	6.1	5.17	5.	4.5	4.33
" Total weight ÷ weight on drivers	1.41	1.63	1.71	1.87	1.11
" Total H. S. ÷ grate area	70.6	51.7	51.6	77.1	67.4
" Tube H. S. ÷ total H. S.	.946	.94	.927	.932	.954
" Tube H. S. ÷ firebox H. S.	18.12	16.3	14.8	13.42	20.25
" Total H. S. ÷ Vol. both cyl.	330	322	322	366	245
" Grate area ÷ Vol. both cyl.	4.68	6.23	6.23	4.74	3.8
" Tractive effort x diameter drivers ÷ total heating surface.	568	650	650	600	765

\*Volume of cylinders of equivalent simple engine used for compounds.

† Servé tubes.

ent indications are that the gear will come into fairly general use in this country.

The two balanced compound Atlantic type engines will be seen, by referring to the tables of dimensions, to be practically identical in all respects except cylinder arrangements. They both employ 16 and 27 by 26 in. cylinders, weigh in the neighborhood of 200,000 lbs. total and carry 205 lbs. of steam. The boiler of the Baldwin balanced compound has slightly longer flues, there being 261—2 1/4 ins. in diameter and 17 ft. 8 ins. long, while the Cole compound of the American Locomo-

locomotive for the Chicago, Burlington & Quincy Railroad in June, 1904, page 211, and for the cylinder arrangement to June, 1903, page 210.

The consolidation locomotive is almost an exact duplicate of a locomotive built by the American Locomotive Company for the New York Central & Hudson River Railroad, and illustrated in the AMERICAN ENGINEER AND RAILROAD JOURNAL, January, 1904, page, 16. The Pennsylvania engine weighs 1,000 lbs. more in total and 2,000 lbs. more on drivers. The tractive power is the same in both cases.