engine will push two cars weighing 42,000 lbs. loaded. The average speed will be five miles per hour; on the 25 per cent. grades it will be three miles per hour, and on the eight per cent. grade, eight miles.

Six cars are building by the Wason Manufacturing Co., Springfield, Mass. Each will have 50 seats, and weigh 21,000 lbs. loaded. Each car will have two pinion brakes worked by hand. The engines will have steam and hand brakes fitted to the gear wheels. In the descent no steam will be used, but the cylinders will act as brakes, being equipped with the Le Chatelier brake.

The principal officers of the road are: Major John Hulbert, President; Mr. R. R. Cable (Chicago, Rock Island & Pacific), Vice-President; Mr. J. B. Glaser, Secretary and Treasurer; Mr. T. F. Richardson, Chief Engineer, and Mr. W. Hildenbrand, Consulting Engineer.

It is said to be the intention of the company to light the whole route by electricity. Those who have ascended Pike's Peak, through the wild gorges of its slopes, and climbed the bald dome of rocks rising nearly 2,000 ft. above timber line, can imagine what a striking spectacle this line of glittering lights, running up to the stars, will be. But many lovers of mountains who remember Pike's Peak before the days of carriage roads, and when there was scarcely a bridle trail, would gladly do without the spectacle, and indeed without the railroad itself.

Traffic Capactty of the New York & Brooklyn Bridge.

[CONTINUED FROM THE RAILROAD GAZETTE OF MARCH 28.]

The condition named above, that the trains shall be moved from the incoming to the outgoing platform without stop or interference, one with another, does not obtain where the transfer is made over switches, as shown in figs. 2, 3 and 4, since to surely prevent collision, *first*, if but one switch is used a train must not leave the incoming platform until the preceding train has passed the clearance point at *F*, and *second*, if two switches are used also a train must not leave the end of the switch *D* until the following train has passed the clearance point at *E*. In the first case, let the time in which a train starting from rest at the incoming platform is run out on the switch and back past the clearance point at *F* be *e*; then that a train from the incoming platform may clear the preceding train,

$$b + p + H = b + p + e;\ \text{hence } H = e; \qquad (12)$$

also,

$$e = \text{or} > p + c; \qquad (13)$$

whence with but one transfer switch in use, the headway between trains on the main lines cannot be less than the time in which a train starting from rest at the incoming platform passes the clearance point at *F*, nor can this be reduced below a certain limit.

In the second case, the general solution as applied to a double slip and switch system is more complex. Referring to figs. 3 and 4, and designating the trains which run on the *A* tracks and switch by *A*, and those on the *B* tracks and switch by *B*; let the times respectively the *A* and *B* trains remain, at the incoming platforms be *p* and *P*, at the switches be *w* and *W*, and at the outgoing platforms be *q* and *Q*; the time in which a train runs from the incoming platform out on its switch or from its switch back to the outgoing platform be *f*; the time in which when running in from the switch it clears the spur at *F* be *g*, and when running out to the switch it clears the crossing at *E* be *G*; also as before, let the headway between trains on the main line be *h*. Mr. Leverich deduces certain general equations for this case, which we give, omitting, however, the successive stops, for want of space.

First.—If the transfer is made by locomotives alone:

$$h = \frac{w + 2f}{2} = \frac{W + 2f}{2},\ \text{and } w = W; \qquad (18)$$

also,

$$h = (p-P) + w + (f-g:) \qquad (19)$$

and

$$p-P = Q-q. \qquad (20)$$

From this it appears that the headway *h* is equal to one-half the time $w + 2f$, in which the transfer from the incoming to the outgoing platform is made; also to the sum of the difference in times $p-P$, a train remains at the two platforms, the time *w*, it remains on its switch and the time, $f-g$, in which it runs from the crossing to the switch. Again for a given headway *h*; the time, *w*, a train must remain on its switch and the difference in times, $p-P$, it must remain at its platforms, have a fixed value; and as *h* is increased, $\frac{w}{2}$ will increase and $p-P$ will decrease the same quantity.

Second.—If the transfer is made by cable and locomotive, that a train may leave the incoming platform, when the preceding train has cleared the spur:

$$h = \frac{w + f + G}{2} = \frac{W + f + G}{2};\ \text{and } w = W; \qquad (23)$$

that s: the headway *h* is equal to half the time $w + f + G$, in which the transfer from the incoming platform to and from the switch and past the crossing is made; other deductions are as for the *first.*

Assuming that a train is not started to or from its switch until its track is clear, and that starting from rest it is moved at full speed or moving at full speed it is brought to rest in two-thirds its length, or for a four-car train in 133⅓ ft.; then *f* may be taken at 40, *g* at 34, and *G* at 26 seconds. Also, that each train coming into the station may begin to stop, if necessary, at a danger point a train length or 200 ft. back from the preceding train on the same track at the incoming platform,

$$h = > \frac{p + R}{2}; \qquad (24)$$

in which *R* is the time required for the train to run from this point and come to a stop at the platform, or 37 seconds. From this data Table IX. is constructed.

It will be noticed that up to 1 minute and 14 seconds headway for trains transferred by locomotive alone, and up to 1 minute headway for trains transferred by cable and locomotives, they are alternately a longer and shorter time at the incoming platforms and contrariwise at the outgoing platforms; and that with headways greater than these the trains may be at either platform a time equal to the headway.

To aid in fixing proper values for the terms in the general equations established above, expressing the several conditions which limit the running of trains as proposed, reference is had to observations made at the two stations, of the movement of trains during the busy morning and evening hours, recorded in Table X.; also at New York station, to determine the time in which trains, starting from rest at outgoing platform were first moved at full speed, recorded in Table XI. In each case the observations were made on several trains running in the usual order; they were operated by the men then assigned to that work, and were performing regular service. [We have condensed these tables, retaining only the means.—EDITOR.]

TABLE IX.—SCHEDULE SHOWING THE RUNNING OF FOUR-CAR TRAINS INTO AND OUT OF A STATION WITH DOUBLE SLIPS AND SWITCHES.

Times are in seconds.

FIRST—TRAINS TRANSFERRED BY LOCOMOTIVES ALONE.

Headways = *h*	40	45	50	55	60	65	70	74
Trains remain on switches = *w*	0	10	20	30	40	50	60	68
Difference in times, trains remain at platforms = *p*—*P*	34	29	24	19	14	9	4	0
A trains remain at incoming and *B* trains at outgoing platform = *P*	57	64	64	64	64	64	64	64
A trains remain at outgoing and *B* trains at incoming platform = *P*	23	35	40	45	50	55	60	64
Platforms are vacant	17	10	10	10	10	10	10	10

SECOND—TRAINS TRANSFERRED BY CABLES AND LOCOMOTIVES.

Headways = *h*	33	35	40	45	50	55	60
Trains remain on switches = *w*	0	4	14	24	34	44	54
Difference in times, trains remain at platforms = *p*—*P*	27	25	20	15	10	5	0
A trains remain at incoming and *B* trains at outgoing platform = *P*	43	47	57	60	60	60	60
A trains remain at outgoing and *B* trains at incoming platforms = *P*	16	22	37	45	50	55	60
Platforms are vacant	17	13	3	0	0	0	0

TABLE X.—ARRIVAL AND DEPARTURE OF TRAINS AT AND FROM THE STATIONS.

THREE-CAR TRAINS.

	Brooklyn station. m. s.	New York station. m. s.
Mean headway of train on the main line	1 29.8	1 30.1
Mean time in which passengers were discharged at the incoming platform	30.8	21.3
Mean time in which trains were transferred from one main line to the other	1 42.1	1 11.9
Mean time in which passengers were received at the outgoing platform	44.2	42.9

FOUR-CAR TRAINS.

New York Station, beginning at 5 o'clock, P. M. Headway, 1m. 30s.

	m. s.
Time in which passengers were discharged on the incoming platform	31.5
Time in which train was moved from the incoming platform to switch	48.8
Time that train stood on the switch	22.4
Time in which train was moved from the switch to the outgoing platform	32.9
Time in which passengers were received at the outgoing platform	40.7
Total time between arrival and departure of train at and from the station	2 56.

TABLE XI.—TIMES IN WHICH TRAINS WERE MOVED FROM REST TO CABLE SPEED AT OUTGOING PLATFORM, NEW YORK STATION; THE LENGTHS OF CABLE THAT PASSED THE STARTING POINT, AND THE SPACES OVER WHICH THE TRAINS MOVED IN SUCH TIMES.

	Eleven trials.	Six trials
Number of cars in train	3	4
Time of movement observed, seconds	14 5	11.4
Length of cable which passed the starting point; computed, ft	213.1	167.5
Space over which the train moved; computed, ft	106.2	83.8

Again referring to the "Typical diagrams of terminal stations," figs. 2–6, collating and applying the data above given, the minimum headway between trains on the main lines will be as follows:

First.—As shown in fig. 2, the minimum headway (equation 12), *H* equals *e*, the time in which a train, starting from rest at the incoming platform, is run out on a switch and past the clearance point. This by computation, assuming that a train thus moved acquires full speed in two-thirds its length, or in 133⅓ ft., without allowance for delay at the end of the switch when the movement is reversed, is one minute and six seconds; by Table X., the mean time at New York station in which three-car trains were transferred, was one minute and 12 seconds, and in which four-car trains were transferred was one minute and 22 seconds; whence under the most favorable conditions for handling the trains, this for four car trains cannot be safely taken less than one minute and 20 seconds.

Second.—As shown, figs. 3 and 4, the minimum headway *H*, permitting trains to remain not less than 40 seconds at each of the platforms, to discharge and receive passengers, per Table IX., is 45 seconds.

Third.—With, at each terminal, double incoming and outgoing tracks and their platforms as before, and double transfer loops, as shown for a triple slip system, fig. 5, whereby the trains may be moved from one platform to the other without stop or interference, also together constituting a double slip system, the minimum headway (equation 10), *H*, is not less than one-half the sum of *p*, the time a train remains at a platform, and of *c*, the time in which the train on departure is moved its length. By computation, assuming as before that a train acquires full speed in two-thirds its length or 133⅓ ft., this last is 23 seconds, which fairly agrees with the observations recorded, Table XI.; whence the minimum headway may be taken at 32 seconds.

Fourth.—With *triple incoming and outgoing tracks*, their platforms and triple transfer loops at each terminal, together constituting a triple slip system, as shown in fig. 5, the minimum headway (equation 11). *H* is not less than one-third the sum of *p* and *c*, or 21 seconds. This is not so great as the minimum headway between trains on the main lines, heretofore taken at 25 seconds; hence, by this system the maximum capacity is reached.

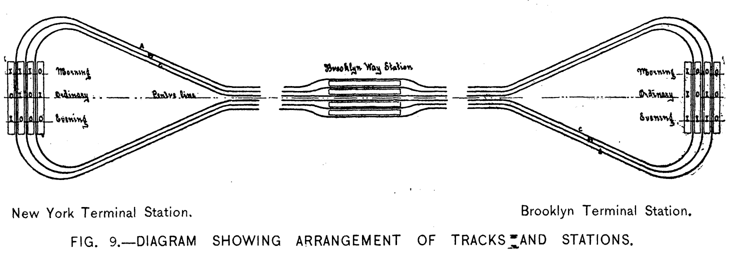
In Table XII. these headways and the number of trains and cars which may be run thereon are collected and compared with headways and trains as at the present time.

TABLE XII.—MAXIMUM CAPACITY OF A PAIR OF MAIN LINES AS LIMITED BY DIFFERENT TERMINAL ARRANGEMENTS.

Terminal arrangements.	Minimum headways.	Number per hour dispatched. Of 4-car trains.	Number per hour dispatched. Of cars.	Capacity compared with 4-car trains running on 1½ min. headway.
	M. S.			
Single slip system with forked switches, as now operated	1—30	40	160	1
First—Single slip system with forked switches, operated to maximum capacity	1—20	45	180	1⅛
Second—Double slip system with forked switches	0—45	80	320	2
Third—Double slip system with loops	0—32	112½	450	2 13/16
Fourth—Triple slip system with loops, as limited by capacity of the main lines	0—25	144	576	3⅗

Mr. Leverich states certain conditions to be observed as to station arrangements and certain improvements required. He shows that the cost of handling cars at the terminals by locomotives is eight and a half times as much as it would cost to do the same work by cables.

That a double or triple slip system may be operated with the greatest possible efficiency and safety; for each part there should be a separate railroad and hauling cable, forming with its main lines on the structure proper, its branches at the stations and transfer switches or loops at the terminals, an entire and independent circuit, without a break in the tracks except where the trains are run from and to the storage-yard; special automatic appliances being inserted where the branches separate from or join to the main lines at the crossings of single tracks. For this, on the bridge structure, the rails of the double or triple systems on the same side of each track should be laid quite close together and with a space between them sufficient to allow clearance of the car wheel flanges; the cables should also run side by side, each in the centre of its pair of rails. The grips should permit the trains to be stopped, started, or run slower or faster than the cable, without dropping it. This arrangement of tracks and cables will allow whole



New York Terminal Station. Brooklyn Terminal Station.

FIG. 9.—DIAGRAM SHOWING ARRANGEMENT OF TRACKS AND STATIONS.

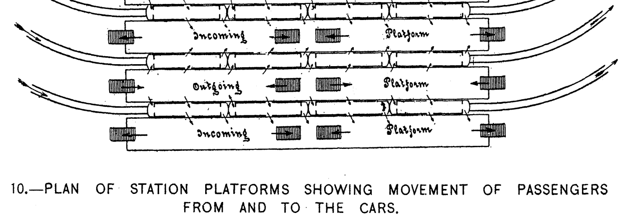


FIG. 10.—PLAN OF STATION PLATFORMS SHOWING MOVEMENT OF PASSENGERS FROM AND TO THE CARS.

Scale, 80 ft. to 1 in.

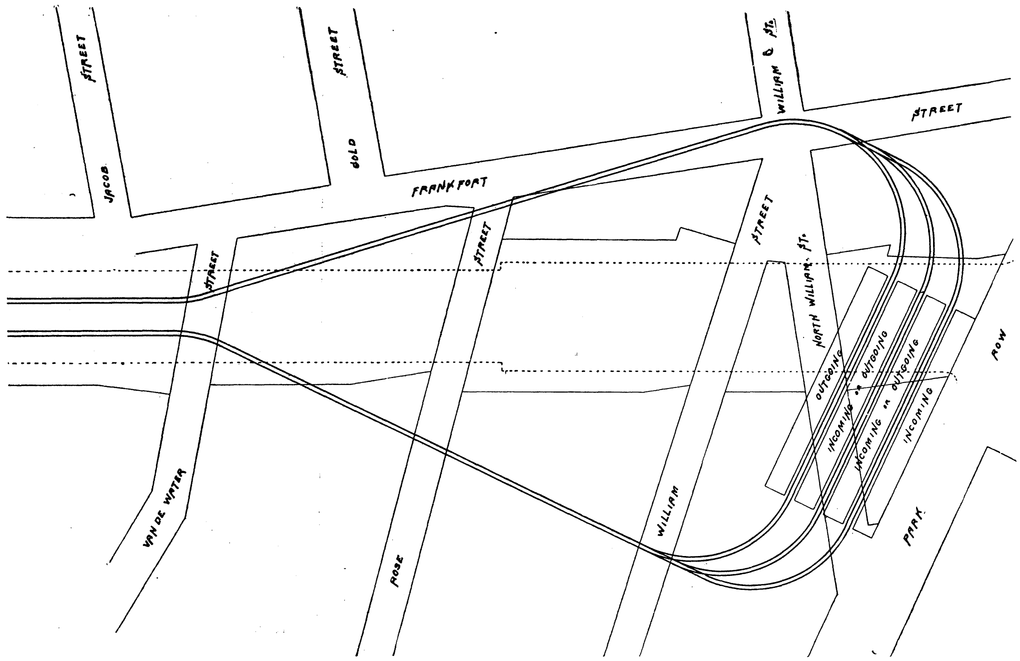


FIG. 7.—PROPOSED NEW YORK TERMINAL, NEW YORK & BROOKLYN BRIDGE RAILWAY.

Scale, 120 *ft. to* 1 *in.*

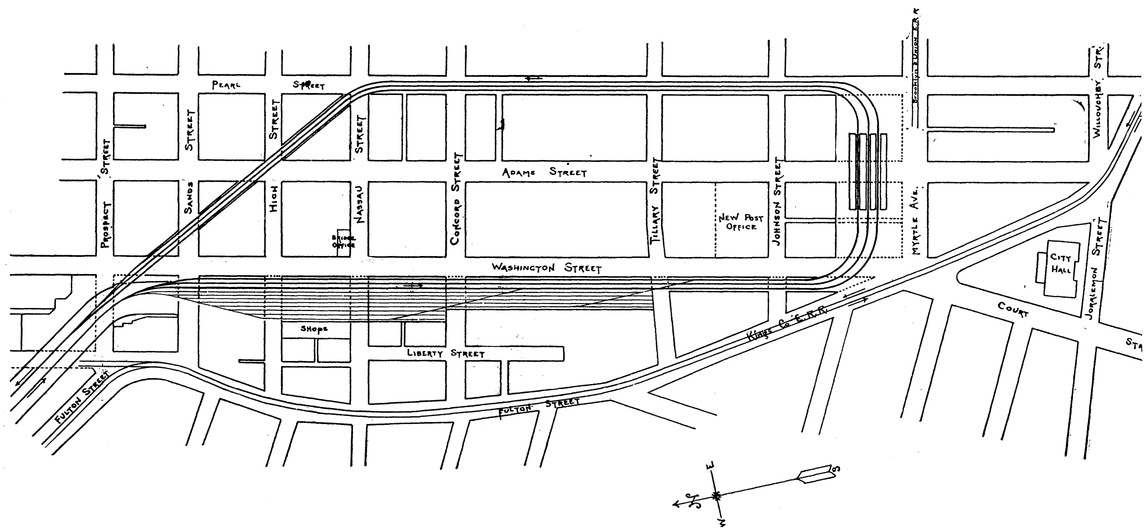


FIG. 8.—PROPOSED BROOKLYN TERMINAL, NEW YORK & BROOKLYN BRIDGE RAILWAY.

Scale, 400 *ft. to* 1 *in.*

or part of the system to be operated as the traffic offering may demand, and in case a single part becomes disabled from any cause, the remaining one-half or two-thirds of the system may still be used as before.

Plan Proposed.—Mr. Leverich reviews the plans heretofore adopted and then develops his own plan at considerable length.

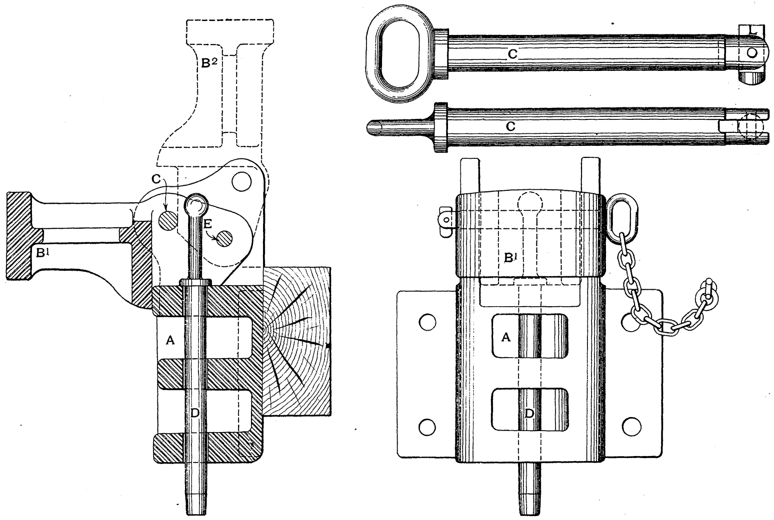
Assuming that the designs heretofore adopted exhaust the capacity of terminal stations arranged on the double slip system with forked transfer switches, studies have been made of other and different designs, of which, that shown in outline, fig. 6, was selected as comprising most that was desirable in the plan for such a station. It embodies a modification of the triple slip system with transfer loops, shown in outline, fig. 5; the loops being separated at the outer ends and joined by tangents, which form the branches of the main lines; and along these branches are placed the passenger platforms; the arrangement allowing the station to be located close to and along the street.

The plan proposed for the New York terminal is shown, fig. 7, and that for the Brooklyn terminal, fig. 8. They are located, each in an open space, and are surrounded by streets; that in New York being on the southerly side of Park Row, easterly of Frankfort street, and with passages for vehicles and pedestrians connecting with William street; and that for Brooklyn terminal station, on the northerly side of Myrtle avenue, centrally over Adams street and between Washington and Pearl streets; a way station in Brooklyn may be located near the one now used. The main lines in Brooklyn from and beyond the bridge entrance on Sands street are separated, the incoming lines being continued southward along the westerly side of Washington street to the curves entering the station, and the outgoing lines from the curves leaving the station, northerly over Pearl street to the intersection with Nassau street, and thence diagonally across the blocks and streets to the bridge entrance.

The buildings for the terminal stations, as designed, are similar in plan and arrangement: each is 320 ft. long and 130 ft. wide; the ground floor, the second floor and a part of the third floor are devoted to the uses of the bridge railroad and of the connecting elevated and surface railroads; the remaining floors—of which there are seven in New York, exclusive of those in the towers, and eight in Brooklyn—are set apart for such purposes as will ensure the largest income from rentals; the intent being that these buildings shall, independently of their public service, yield a fair annual return on their cost, including that of the land they occupy. The arrangements for this service in each are essentially alike, and a description of a part used for a station in the building in New York will apply, except as noted, to that in the building in Brooklyn. On the ground floor is one large waiting room for passengers to and from the street, two suites of retiring rooms and two booths for the sale of tickets; on the second floor are the three branch tracks, 30 ft. apart between centres, and four passenger platforms, each 225 ft. long and 20 ft. wide; and on the third floor is one large waiting room for passengers to and from the connecting elevated railroads, a suite of retiring rooms and two booths for the sale of tickets. Downward from each platform to the street floor are four stairways, two in the centre and one at each end, and upward in the centre to the elevated railroad floor, in Brooklyn stations are two stairways, and in New York station is one stairway from each platform, except the outer, from which a direct passage leads to the elevated railroad. All stairways are eight feet wide.

The manner of running the trains into the stations, the use of the passenger platforms and the movement of passengers are illustrated by fig. 9, showing the three separate circuits, *A*, *B*, *C*, and the stations with their platforms; and fig. 10, showing the trains discharging and receiving passengers and the direction of movement. Generally, the incoming and outgoing platforms will be as designated, fig. 10, and as "Ordinary," fig. 9. On special occasions, when the travel is large and much the greatest in one direction, and sometimes, perhaps during the busy hours, morning and evening, by opening or closing gates at the entrances to the stairways, on the street floor, the common use of the two central platforms at the stations may be changed; so that for instance, as indicated fig. 9, during the morning hour there will be in use at Brooklyn station three outgoing and one incoming platforms, and at the New York station three incoming and one outgoing platforms; at each station there are to receive and discharge passengers, when the three tracks are used, four platforms together 80 ft. wide, 16 stairways downward to the street floor together 128 ft. wide, and in the Brooklyn station eight stairways upward to the elevated railroad floor together 64 ft. wide.

When the bridge railroad is operated up to its maximum capacity, as herein described, a train will make a round trip in about 23 minutes, there will 54 trains of four cars each in use, or 18 trains on each of the three circuits; and the headway between trains on the main lines will be 25 seconds. By ceasing to operate one or two circuits, the time the trains remain at the platforms



HEINTZELMAN'S TENDER DRAWHEAD, WITH MOVABLE BUFFER.

being unchanged, the capacity will be reduced one-third or two-thirds, and the headways between trains on the main lines will be increased to 37½ seconds, or to 1 minute 15 seconds respectively. If desirable from the diminution of traffic, these headways may be increased while operating all or part of the circuits. To thus lessen the number of trains running, as the hourly traffic demands, the trains on a circuit to be cut out may be left standing on the separated main tracks of that circuit, between the bridge entrance and the Brooklyn terminal station ready for movement whenever that circuit is again to be operated. Thus generally, whenever the variation of traffic during the day requires it, the number of trains to be moved may be reduced or increased one-third, two-thirds, or more, without switching or hauling the trains from or to the main lines. For reserve and disabled cars, a storage yard in Brooklyn, located as shown, fig. 8, outside of the loops and extending from the bridge entrance, southerly parallel to Washington street, is designed with transfer switches and tracks so arranged that cars to and from the yard need not in any case be moved from or to the main lines, in face of the regular passenger trains.

Elaborate drawings of the floor plans and elevations of the proposed stations accompany the pamphlet.

Heintzelman's Tender Drawhead with Movable Buffer.

The drawhead with movable buffer shown herewith is so clearly represented in the engravings as to scarcely call for description. *A* is the drawhead and B^1 the buffer in position for use; and B^2 when turned up out of the way. This pivots on *E* and is held in either position by the pin *C*. The pin is held by *L*. *D* represents the coupling pin.

This construction was designed and is patented by by Mr. T. W. Heintzelman, Master Mechanic Southern Pacific, Sacramento, Cal., who will give any desired information about it and grant rights to use it. Concerning it he writes: "You will readily see the advantage gained by its use in coupling to passenger and freight cars as compared with using the rigid buffer casting, which always necessitates using a drawbar of sufficient length to clear the dead woods or the ends of the cars. This drawbar, or long link, oftentimes bends so as to allow the buffer to jam into the end of the car, causing damage. On the other hand, in using the plain freight draw casting to couple the Miller hook or other passenger drawbar, without having the buffer to relieve the inward pressure on the drawhook while handling passenger train cars, the result is generally known to be damaging to the equipment.

"The extra cost of this device above the common pattern of castings is the drilling of the three pinholes for the pins *C* and *E*, and making the pins, which are put in as they come from the forge, and drilling the small pinholes in the end of each."

Stayless Locomotive Boilers.

At a meeting of the Verein für Eisenbahnkunde, Berlin, held last December, Mr. G. Lentz described in much detail a system which he has developed for constructing locomotive boilers without stays. He showed designs for a variety of service. We reproduce two of them from Glaser's *Annalen*.

Fig. 1 shows the design for a standard freight locomotive for the Prussian state railroads. As seen from the sketch, the front water space with its large flat surfaces and many staybolts is entirely done away with. About the middle of the length of the boiler, where the greatest evaporation takes place, the shell is the highest, and the steam dome is located here where the steam is the driest. The boiler is not so large in the centre but that the engineer and fireman can easily see over it. The front is made of a cast iron plate, provided with an air circulation and covered with non-conducting material.

Mr. Lentz says that at first sight it might seem to many, as it did to him, that as soon as subjected to internal pressure this curved boiler would have a tendency to straighten out, similarly to the tube of a Bourdon gauge, and that in consequence the circular seams would be considerably strained. Further consideration will show that this is not the case, however. The spring tube in the Bourdon gauge is oval in section and not circular, as is the boiler. Practical proofs are not wanting to show that this tendency to straighten out does not exist. For instance, the coils of pipe used in ice-machines—coils about 19 to 60 in. in diameter, of pipe 1 to 2 in. in diameter—when subjected to an internal pressure of 1,200 lbs. to the square inch, do not show the least tendency to straighten out. though they can be sprung easily with the hand. Or another more common example, two sections of a steam pipe connected by a right-angled elbow. No one would imagine for a moment, that as soon as the steam pressure is put on, there is any tendency towards the straightening out of the pipe into a straight line, and the rupture of the elbow. And this being the case, how should this tendency to straighten out exist in the boiler, which is only very slightly curved longitudinally?

The characteristic peculiarity of this boiler consists in its tapering ends, the section of which is at every point circular, and in its circular corrugated firebox, by means of which freedom of expansion is obtained and longitudinal bracing is done away with. A small dome is provided near the front end of the boilers for convenience in attaching the mountings.

The corrugated firebox is inclined and ashes fall upon the inclined bottom plate, and from this into the ash box. The firebox is supported from below or from the shell. By the construction all staying and stay bolts are done away with, and the cost thereby considerably reduced. The ordinary Prussian freight locomotive boiler contains about 445 staybolts.

The combustion chamber can be arranged in various ways, and fig. 1 shows it provided with an opening for the removal of the cinders and combined with a mud drum. The opening for the removal of the cinders can be made large enough in diameter to serve as a manhole for entrance into the firebox back of the bridge wall.

Mr. Lentz showed sketches of several other boilers of the same style, and pointed out their advantages over the ordinary firebox boiler, so far as the freedom in arranging the positions of the axles to obtain an equal loading of them is concerned.

The good points of this system of construction, according to the author of the paper, are as follows:

The first cost is reduced $1,000 to $1,250; the cost for repairs is greatly reduced; the working pressure can be increased; the better combustion makes a saving in fuel the firebox remains clear and the evaporation is better; the firebox and tubes can easily be renewed; the boiler being plain, exteriorly, *i. e.*, without a square projecting firebox, the axles can be better arranged on new locomotives.

Fig. 2 shows a design for an express locomotive for the Prussian State railroads.

Accounting Officers' Recommendations.

Secretary C. G. Phillips, of the Association of American Railway Accounting Officers, has issued a circular to members giving a summary of the recommendations passed by the meeting of the association at New Orleans Jan. 22 last. The topics embraced are: 1. Information to be given on each coupon of inter-road tickets. Each coupon should show the whole route, and where feeders are used the information should appear on both feeder and ticket. It is desirable to present this subject to the General Passenger Agents' Association. 2. Method of accounting for exchange orders. Tickets issued in exchange should be shown in regular report, without revenue, and a separate statement of the value of orders should be made. A standard blank is given in the appendix to the circular. 3. The Association also approved of standard blanks for report of coupon ticket sales, claim for correct proportions and claim for unreported tickets. Samples of these are given. 4. The Association recommends that connections be notified by telegraph of stolen or counterfeit tickets, and the notice confirmed by mail. 5. Excess baggage collections should be reported separate from coupon ticket sales, but the total of the baggage should be added to the ticket report. 6. Revenue for coupon ticket sales should be reported in gross, and payment for commission or other purposes should not affect the divisions. 7. Where deductions are made for tickets redeemed the tickets should accompany the report. 8. Where a claim is made for an unreported ticket or coupon the ticket should be sent as a voucher. 9. A uniform bill of lading is desirable, but conference with officers of other departments will be necessary. 10. Way-bill corrections should not be made where the error is five cents or less, but errors affecting the settlement of balances should be corrected, however small. 11. Old material should be credited to the account directly affected, at a fair market value, and debited to material stock account until sold or charged to another department. 12. It is the sense of the Asso-

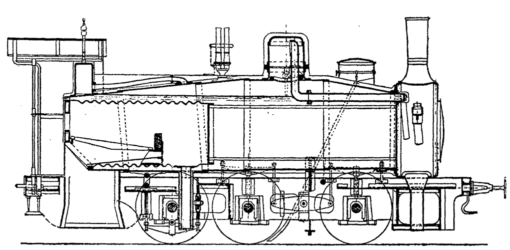


Fig. 1.—Locomotive for Freight Service.

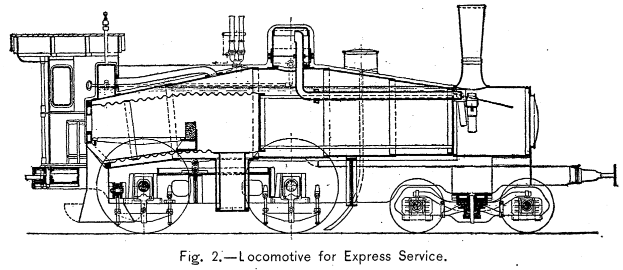


Fig. 2.—Locomotive for Express Service.

LOCOMOTIVE BOILERS WITHOUT STAYS.

DESIGNED FOR THE PRUSSIAN STATE RAILROADS.