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## THE ALTOONA SHOPS OF THE PENNSYLVANIA RAILROAD.

II.

(*Continued from Page* 93.)

The proceedings of the two conventions held in Saratoga in June occupied so much room in the July number of the AMERICAN ENGINEER as to crowd out the second article on the Altoona Shops. As it was thought that this could be written better on the ground than from notes made during a previous visit, a second journey was planned, partly to escape the heat of New York and to enjoy a sojourn among the hills, where Altoona is located, and also to refresh recollections of the subjects noted in a previous visit. Having a decided aversion to sleeping cars when the thermometer is in the neighborhood of the nineties, the train which leaves New York at 2 P. M. was chosen for the journey. At that hour the thermometer was balancing in the vicinity of 90 degrees or above, and therefore an ordinary coach was taken at Jersey City in preference to a drawing-room car, for the reason that the latter are apt to be insufferably hot in warm weather when they are run in vestibuled trains. In coaches windows are kept open, and a circulation of air is thus obtained, whereas in drawing-room cars there seems to be some reason why the windows must be screened if they are opened, and ordinarily there are only a few screens for the many windows. The coach selected was immediately behind the dining car in the same train. A brisk westerly breeze was blowing into the great trainshed in Jersey City, with the result that the combined odors from the kitchen of the dining-car were wafted into that behind it. This is often, and was then, very disagreeable in vestibuled trains, but is especially so on a hot day. After theorizing about bad smells a good deal the conclusion reached is that there are a great many railroad men who are color-blind in their noses. As evidence of this it may be said in designing drawing-room and sleeping cars, instead of putting the door of the smoking-room toward the end of the car, they are often placed so that they face toward the middle of it, or possibly toward its side, so that when a current of air enters the front end door, as it will when the train is in motion, it drives the smoke from the apartment where bad cigars are consumed and worse stories are told, into the middle of the car. In the much vaunted but viciously ventilated vestibuled trains a carefully constructed conduit is provided which carries the bad smells and the foul air from one end of the train to the other, so that the occupants of the rear cars must breathe a sort of atmospheric hash consisting of the odors of tobacco, multitudinous smells from the kitchen and scullery of the dining-cars, the exhalations from the lungs and bodies of washed and unwashed travellers, and when the latter take their boots off the air literally becomes *fetid*. This conduit is constructed at great expense, it adds largely to the weight of cars, is an obstruction in getting in and out of them, makes the train harder to pull, and forms a sort of trap for collecting microbes and the seeds of disease and death. There are trains of this kind which also run out of the Pennsylvania station in Jersey City, the cars of which are marked "*F. F. V. Limited*," which connect with some of the Virginia railroads. A traveller, who took one of these trains, and found the ventilation very bad, interpreted this lettering to mean "fright-fully ventilated." Our criticism is that vestibules make trains very warm in summer, and that by preventing the escape of bad air, and the entrance of that which is pure between the cars, they make good ventilation more difficult than it is without them; that ingress and egress to and from the cars is more inconvenient than it is when vestibules are not used; they are expensive and heavy, and the advantages do not compensate for these disadvantages. Simple gates in the platforms would make the passage from one car to another secure, which is all that seems to be demanded.

It is not often that any good reason can be found for criticising the Pennsylvania Railroad cars. There is though, it is thought, good ground for finding a little fault with the fastenings of the windows and blinds in some of their coaches. In the first place there is no provision made for holding the window sash or the blind in any position in which it may be desirable to have it. There is but one stop so that the window must be wide open or closed entirely. Often it is desirable to have the sash raised only a few inches, and the blind lowered part way to keep the sun out, but not to obscure entirely the view. The fault with the fastenings is that some of them will not fasten, and one blind could not be moved at all. Surely the mechanical genius of the Pennsylvania Railroad is able to devise something more effective than what they are now using. Of course these are hard times and what with the threats of free silver, bad business and general distrust we probably will be obliged to be content with defective sash locks, at least for the present.

After emerging from Jersey City the first greeting was a prolonged whiff of bad odors from the manure piles on the meadows near the Pennsylvania Railroad shops. One cannot help but drop a word of sympathy for the masters in charge, and the men employed in these shops who must endure the stench which exhales perpetually from this locality. Happily for mankind it becomes accustomed to all sorts of disagreeable things, odors among others, and our friend the editor of the *Master Mechanic* intimates that he enjoys vile perfumes such as tobacco, onions and skunks, and seems to thinks that those who do are in some sense superior to those who do not. The train swung through Newark and then to the real country, which God made, and we soon glided to the leeward of a hay-field, with real hay-cocks, and the aroma of new-mown hay. Thanks to Colonel Waring, the the odor of the streets of New York is not as bad as it was in the days when Tammany held sway, but even now the metropolitan atmosphere in July is not suggestive of perfume, so that the smell of the hay-field, as it was swept into the windows of the car, seemed like incense, and suggested the experience of long ago when hay-making was one of the occupations of the writer and he was free from the drudgery of squeezing ideas out between the nibs of a pen. How fresh and grateful the country looks to one who sees daily little excepting bricks and mortar! In some of the fields the grain was freshly cut, the corn just ready to burst open with its crown of glory, the grass and foliage in its full midsummer luxuriance, and every tree seemed to be clad in coronation robes in honor of us poor mortals who come to look upon them. Verily those of us whose daily lives are spent apart from these glories, of which nature is so lavish, lose much that makes life worth living.

The 2 P. M. train is a fast one, so we were whirled through Elizabeth, with its new elevated railroad above, and clear of the the New Jersey Central crossing where for so many years the only guardian angel who stood between death and thousands of people who traveled on the two roads was a faithful Irishman with a red flag by day and a red light by night. Happily the danger of this grade crossing is now non-existent, and the traveler who knew of it is no longer obliged to hold his breath—as some of us did—every time we reached this dangerous intersection of two roads. Rahway came and vanished. New Brunswick, with the quiet college shades in sight of the road, as we whirled past the old superannuated station: Princeton Junction, with the trees and spires and towers of the seat of learning in view, in the hazy distance, all robed in the panoply of midsummer. To a person who has traveled for nearly half a century by rail between New York and Philadelphia, it is a little unexpected to pass through Trenton without being delayed, and without stopping or being greeted with the cry of peripatetic train boys of "fried oysters and ham sandwiches." The train on this occasion did not stop. Trenton is the seat of Jersey politics and potteries. The train crossed the Delaware River quickly on the strong iron bridge, which recalled the old creaky wooden structure which years ago occupied this

place and had to be crossed at reduced speed, and also brought to mind that it was not very far from the site of the bridge that Washington made that celebrated crossing of the Delaware on a Christmas eve, the sequel to which was of such momentous consequence to all of us.

On the Pennsylvania side of the Delaware the canal and slow-moving boats was suggestive of the past, and a number of bicyles and riders on the tow-path were indicative of the present. The contemplative canal-boat and the ruminant mules made a strong contrast with the alertness of the riders as they appeared in the shaded path which would have made a good subject for a picture representing the past and the present.

In Pennsylvania the well-cultivated fields were soon in view; there were more hay and grain fields, luxuriant corn, market gardens, green trees—beauty, fragrance and delight. The outlying suburbs of Philadelphia, which extend almost all the way to Trenton, with their shops and factories, looked warm and uncomfortable in the July temperature; but the air of comfort of many of the residences is unmistakable. The outlying portions of Fairmount Park were soon reached with its pathetic bronze statue of the wounded lioness, below the railroad the Zoological Gardens, the Art Gallery—a reminder of the Centennial Exhibition—which it seems impossible could have been held twenty years ago, and then a brief stop in the Philadelphia depot, which was hot and stifling, and after the seats were reversed the train was again headed westward.

A glimpse of the well-equipped repair shops of the Pennsylvania road, a rather smoky and dusty ride through the long yard, where there is an ascending grade, extending for some miles beyond, and we come to the matchless suburbs of Philadelphia, where her well-to-do people have made their homes.

A touch of tropical luxuriance seems to be apparent here, if we compare the foliage and the landscape with that east of the Delaware River. The ground west of Philadelphia is beautifully rolling, with groves of magnificent trees—oaks, chestnut and walnut. Some kinds appear here, such as the catalpa, Lombardy poplar, tulip-tree, sassafras, etc., which are not common in New Jersey. Truly it is a goodly land, and those old companions of William Penn acted wisely when they placated the Indians and took up their residence here. The wealth of Philadelphia has been lavished on this region. For a distance of 20 miles or more from the city there is a continuation of beautiful houses with ornamental grounds which nature, art and a protective tariff have combined to beautify. Many of the officers of this great road live in these places, and every facility for getting to and from their homes is given to the residents. Beautiful and convenient stations are located all along this portion of the line, and if the highest achievement of man, as it is said to be, is the creation of beautiful and happy homes, the residents here have certainly accomplished part of that end.

On the date of the journey which is here described the country was at its best. Recent rains had developed the foliage of the trees, the grass and the crops to their full perfection, and the heat of summer had not yet parched or withered any of them excepting the new mown hay. To a tired journalist baked and parched like a ball of pop-corn, and wearied by a metropolitan struggle for existence, the walks, verandas, nooks and shady places and well-made roads looked exceedingly attractive. What capacity for work such daily refreshment must give, what contentment and felicity must come if the household in such houses accords with their external appearance.

After the top of the long grade was reached the shower of cinders was less copious and exasperating. The magnificent view of Chester Valley was then revealed from a high ridge, which had been gradually ascended from Philadelphia. It would require the descriptive powers of Sir Walter Scott or Ruskin to do it justice. Here the suburban residences of city people are no longer seen and the homes of the true rural residents of Pennsylvania are indigenous. The land seems to exude fertility and fatness, and prosperity and comfort are apparent everywhere. In one of the fields a reaping machine was sweeping away the golden grain, a wagon with a typical team of Pennsylvania horses and attendants, fat as the horses, in a grayish afternoon sunshine, the distant hills, hazy and soft in their outline by reason of a light veil of cloud which hung over it all made a beautiful scene. But the accusation of an attempt at fine writing will hold if this vein is continued, and as this article is intended to be descriptive of railroads, and not beautiful scenery or Pennsylvania farms it must be enough to say that the train glided on and on continuously, with only a slow up at a junction, from Philadelphia to Harrisburgh, through the surpassingly fertile and well-cultivated farms of Chester and Lancaster Counties, than which there is perhaps no richer farming land in the world. A brief stop in Harrisburgh after nightfall and the train again sped its way westward. A comfortable dinner in the dining car followed, but observation of the landscape was shut off by the darkness. Dining might be called an excercise of introspection, and to that an hour was devoted satisfactorily. About as much more time elapsed and the electric lights about the Juniata shops came in sight, and we were soon comfortably housed and roomed at the Logan House. Nothing which would interest our readers elapsed between then and the next morning, excepfing that appointments were made to visit the shops and plans were formed for seeing and hearing whatever could be learned and observed that would be likely to interest the reader and the writer.

### CLASS L ENGINES.

Our first article on the Altoona shops contained a view made from a photograph of one of the recently built Class L engines, with a view taken at the same time, and on the same plate of a class G engine, built in 1878, which showed in a very striking way the difference in size and appearance of the two engines. It was then promised that a fuller description of the most recent of these would be given. Through the courtesy of the able head of the department of mechanical engineering at Altoona we are able to give the a diagrammatic view on page 168 of one of these engines, of which some thirty or more have been built, and which are giving excellent service, and we are also indebted to the same source for the following data concerning them:

Their cylinders, as will be seen from the diagram, are 18½ by 26 inches; the driving wheels are 80 inches in diameter; the grates 10 feet long, and, as the firebox is on top of the frames, the width inside is about 42½ inches; the barrel of the boiler is smallest next to the smokebox, where it is 60 inches diameter, from which it tapers backward to a point about midway between the smokebox and firebox, where the tapered portion unites with a cylindrical ring or plate 68 inches diameter. The location of the dome, etc., can be understood more easily from the diagram than it could be from a description.

The fire-box is of the Belpaire type, in the construction of which some important improvements have been made. The crownsheet is flat and horizontal both longitudinally and transversely. In order to allow of the upward expansion of the crown staybolts at the front end the two front rows and some of the ack stay bolts are fastened to the top plate, as shown in the sectional view Fig. 1 herewith, from which it will be seen that a brass thimble is screwed into the roof plate from the outside and the staybolt passes up through this without being screwed into it. A nut screwed on the top end of the bolt rests on a spherical washer, which has a bearing to correspond on the top of the thimble. A cap which covers the end of the bolt and its nut is then screwed in an external thread, on the thimble and serves to make this fastening steam tight. The illustration shows that the bolts are free to move upward, when the firebox is first expanded by the heat, and they are thus relieved of undue strains from this cause. When the shell becomes heated it expands and thus brings the washers to a bearing on the thimble. The ends of the bolts are riveted over the nuts, so as to prevent them from unscrewing. The lower ends of the crownstays are screwed into the crownsheet, but have button-shaped heads below the sheet, with rounded fillets between the heads and the threads on the bolt. Square heads are forged on the lower ends of the bolts to screw them in, but these are cut off after

the bolts are in their position. The other crown bolts have similar fastenings in the crownsheet, but are screwed into the roof-plate and have a cap nut on the outside. The stay-bolts on the sides of the firebox are located as nearly horizontal as was practicable to permit the inside and outside plates to expand and contract as freely as possible without straining the bolts. The strains to which such bolts are subjected when they stand at a considerable angle to a horizontal line has been repeatedly pointed out, but notwithstanding that fact, the vicious

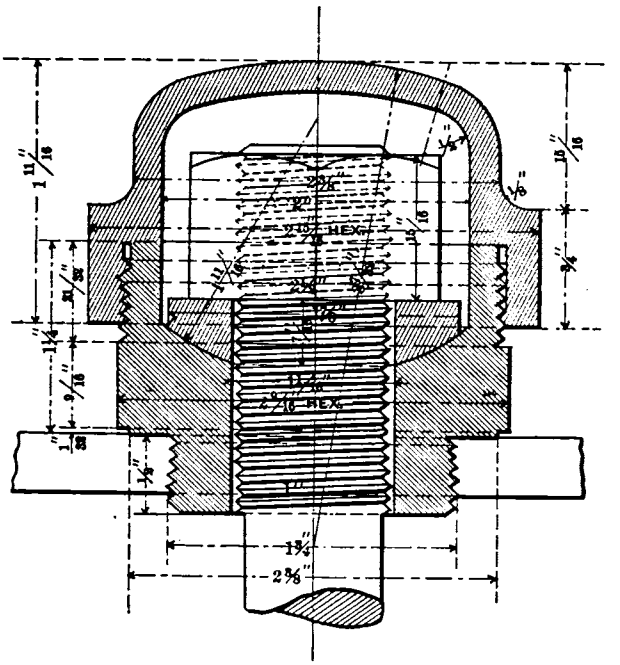


Fig. 1.—Expansion Staybolt.

practice of so arranging staybolts is still continued in many cases. The transverse rods over the crownsheet, which are so essential in the Belpaire boiler, are screwed into the plates and have an ordinary nut on the inside and a cap nut outside.

The water space on the sides and ends of the firebox is four inches wide, but the outside shell at the front end of the firebox is swelled out to the diameter of the largest ring of the barrel of the boiler. The square portion of the outside shell above the crownsheet is somewhat narrower than than the largest diameter of the shell so as to give as much room between it and the cab as possible. What may be called the swollen protuberance of the side sheets, back of the tubesheets, is gradually narrowed or "runs off to nothing" at the back end of the firebox. The object of this lateral extension of the side-plates, back of the tube-sheet, is to give a convenient connection with the barrel of the boiler, but chiefly to give more water space between it and the firebox at this point.

The mud ring is double riveted all around. The radii of its inside corners are three inches. This permits the use of a number of rivets in each corner extending all the way through the metal of the ring. The outside contour of the angles of the mud ring are described from the same center as the inside corners are. The through rivets must therefore be radial to the inside and outside curves, and their outside ends are necessarily further apart than the inside ones are. Patch bolts are therefore screwed into the ring and pass through the external plates between the through rivets. The inside end plates have flanges to conform to the corner of the mud ring. The corners of the plates are reduced in radius as they rise above the mud ring and the flanges are made to correspond thereto.

The diagonal braces which are used to strengthen the ends of the firebox shell are attached to the flanges of trough or channel shaped plates riveted to the ends of the external shell. The same sort of attachment is used on the roof for thin braces. They have the advantage not only of providing a good fastening for the braces, but of stiffening the plates to which they are riveted.

The front plate of the shell of a Belpaire firebox is difficult to flange, and has been regarded as a serious objection to the use of this type of boiler. In these engines, instead of making it of one piece it is made in two. The lower part is made in one piece, and extends up on the sides to within about six or eight inches of the center line of the boiler. The top portion is also made in a separate piece and extends down on the sides to within about the same distance of the center line. The cylindrical plate which forms the back ring of the barrel of the boiler is then cut so as to connect these two sections of the end and to the side plates of the shell.

The horizontal seams are all made with butt-joints quadruple riveted. The outside covering plates are 6 inches wide and the inside ones 12 inches by ⅝ inch thick.

The smoke-box extension is made of a separate plate from the main part of the box. The latter has a wrought iron ring at the front end to which the extension is bolted. This is done so that it can be removed, which is often desirable when work must be done in the smokebox.

The inside arrangements of the smokebox were designed by Mr. Wallace, of this road, and of this we expect to publish an engraving before long.

Especial attention has been given to facilities for washing out these boilers. With this in view besides the ordinary wash-out holes in lower portion of the firebox, three holes, with caps bolted over them are placed in the under side of the barrel conveniently located in its length. The front and back holes are 3 in. in diameter, and the middle one 6 in. Two three-inch holes are also placed on top of the barrel, back of the front tubesheet, and two in the angles on each side of the top of the firebox shell, one pair being near the front on one side and the other pair near the back on the other side. Observation has taught in Altoona, as it probably has elsewhere, that an important element in keeping boilers clean is to have sufficient force to the stream of water which is used in washing out the boilers. Special attention is now given to this, and better facilities are being provided to furnish a water supply of adequate pressure for this purpose.

The grates used in the class L engines are of the finger-bar shaking type. The bars or shafts extend transversely across the firebox, the fingers being 10 inches long measured from the end of one to the end of that opposite to it. The bars, and the spaces between them, are ½ inch wide. At the front end of the firebox there are two dead plates which occupy 33 inches measured in the direction of its length, and back of these is a perforated drop plate 14 inches wide which can be turned so as to dump the fire into the ashpan. The grate-bars are carried on bearing bars of the usual form, bolted by lugs to the bottom of the mud ring. Special pains have been taken, of late, by the authorities in Altoona, to close up all openings around the sides of the firebox so as to exclude cold air from entering at such places. The object of this is twofold, one to keep the cold air away from the fire-box plates, and next to keep the fire away from them, as contact with the cold plates always has the effect of checking combustion. In the class of engines which is here described the bearing bars stand away from the sides of the firebox. In order to close the crevices which are thus left, cast-iron blocks are made which fit in between the bars and the plates, and with a sort of flange or head which laps over the top of the bar. These blocks are simply dropped loosely into the spaces referred to, and the flanges or heads close the openings. In some other classes of engines inclined plates are fastened to the mud-ring and bear against the sides of the firebox, and have joints formed by grooves in the plates filled with asbestos. This makes them almost air-tight.

The check valves are of a pattern designed by Mr. William Wright, chief draftsman, and are inside of the boiler. The valve itself is of a simple conical mushroom pattern, attached to a seat which is removable from the outside. Any injury to the feed pipes outside would not disturb the valve. The horrible accident, which occurred at Pittsburgh a good many years ago, when a whole car full of passengers were scalded, many of them fatally, by the

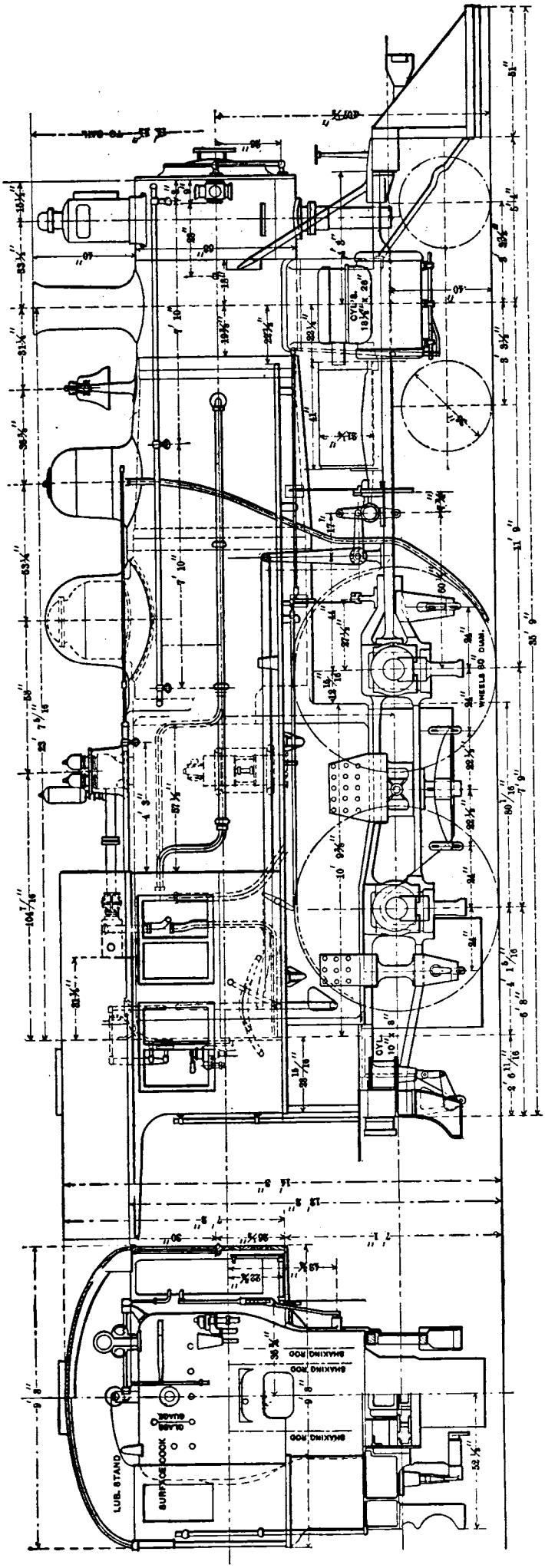

Fig. 2.—Outline Diagram of Fast Passenger Engines, Class L.—Pennsylvania Railroad.

water which escaped from the check valve of an engine, which ran into the rear end of a standing train, has led to the general adoption of inside checks on the Pennsylvania road. The example should be followed by other companies. Another feature, which has been adopted for greater security against such accidents, is cast-iron brackets for running boards. These are made very strong where they are bolted to the boiler, but the projecting part is made with only strength enough to support the loads which they must carry. A comparatively slight blow will break off such a bracket and leave the attachments to the boiler intact, whereas, if a heavy wrought-iron bracket is used, it is apt in a collision to pull out the bolts by which it is fastened to the boiler, and allow the steam or hot water to escape.

The long runs which are now required of passenger engines make it necessary to give especial attention to the oiling arrangements. Of course, ample bearing surfaces are a great help to lubrication. The links in the engines here described are made three inches wide, and they are so made as to provide suitable attachments for oil cups for oiling the pins, by which the rods are attached. Separate oil cups are also attached to the link hangers. The blocks instead of being made with the flanges on one side solid with the block, and a loose plate on the other, are both loose so that when they are worn they can be reversed from one side to the other. They are fastened with two bolts and two studs.

The crossheads and guides of these engines are of a new design by Mr. Vogt, Mechanical Engineer, which we hope to illustrate in a future number.

The piston-rods are fastened to the crossheads with a somewhat obtuse taper and with a bearing against the end of the rod. A rather "cute" expedient is adopted in making the slots in the piston-rods and crossheads. The key is of course tapered, and its back edge must bear against the rod to force it into the socket, and its front edge must rest against the crosshead. The slot in the rod is therefore cut square with the outside of the tapered portion of the rod, and consequently conforms with the tapered form of the key. The form of the back edge of the key slot in the rod does not matter because the key don't touch it. The slot in the crosshead is made square with the axis of the rod, and coincides with the back edge of the key, which stands vertical. The form of the front edge of the key seat in the crosshead is of no consequence because the key don't bear against it. It is therefore not necessary to make either of the slots tapered, which saves considerable work.

The rockers also have some peculiarities. They are made of wrought iron, the shafts being 4 inches in diameter. Between the two arms are two collars which divide the shaft into three parts, the two outer ones alone being used as bearings, which work in bronze bushings made in two parts and held in the rocker-boxes. The collars provide additional end-bearings to resist the wear of the rockers in that direction.

To avoid the awkwardness of making and of handling the lifting shafts when the arms are all forged on, the vertical arm is made separate from the shaft. A circular flange is made on the end of the shaft and is turned up with it. The arm is then bolted to it with six bolts.

The main and coupling rods are fluted, the "big-end," as our English friends call the main stub-end, is of the forked pattern, and the coupling rods have solid ends and bushings.

One of the appliances which is used on these and other passenger engines on this road is the Moran flexible steam joint between the engine and tender, for conducting steam for heating the cars, from the locomotive boiler to the train. This is shown in Fig. 3, which is a view taken from near the ground looking upward from the engine toward the tender. The device consists of a system of ball joints and pipes which form a flexible steam-tight connection, to take the place of rubber hose. Fig. 4 represents an external view of one of these ball joints, and Fig. 5 is a sectional view. The principal feature in this joint, and which has made it successful when other joints have failed, is that it is made with a certain amount of play or looseness, and it becomes steam-tight by the internal pressure bringing the spherical surfaces in contact with each other, and holding them thus, so long as there is any pressure in the pipes. When there is not, there of course is no occasion for the joint being tight. A relief valve

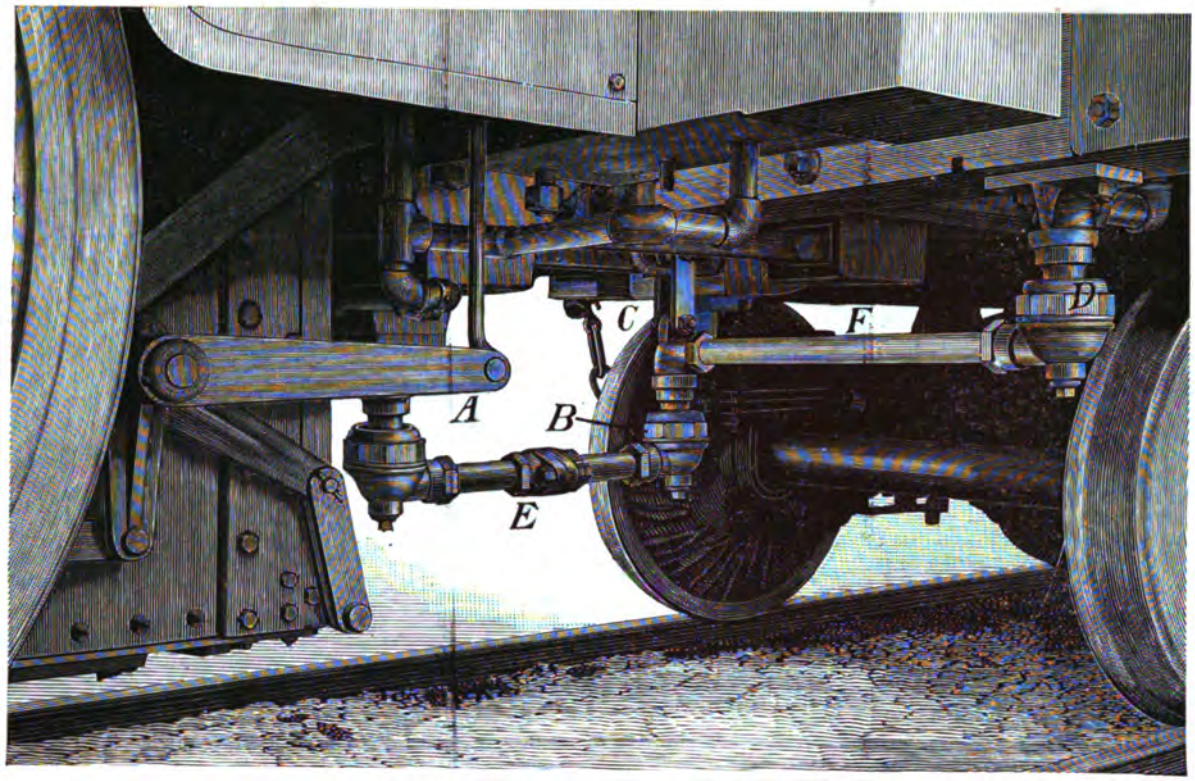


Fig. 3.—Moran Flexible Steam Joint Between Engines and Tenders on Pennsylvanin Railroad.

is shown in the lower part of Fig. 5, which consists of a ball which is raised by a spiral spring below it. When there is pressure in the pipes this ball is pressed down and on the seat below it is then tight, but when the pressure is released the spring raises the ball and allows any condensed water in the pipes to escape. Referring to Fig. 3, *A* is a ball joint connected to a fixed pipe in the engine. *B* is a similar movable joint, which is suspended by links *C* from a trolley above, which has a certain amount of longitudinal movement to compensate for that between the engine and tender. *D* is a third ball joint attached to a fixed pipe on the tender, which extends backward and connects with the train behind it. *A* and *B* are connected together by a pipe *E*, and *B* and *D* by a pipe *F*. As the latter stands crosswise and as *B* can move longitudinally, and all the joints are flexible, it is obvious that this form of connection can adjust itself to any position that the engine and tender can assume on the track when coupled together. This system of connecting pipes has been made a standard on the Pennsylvania road, and, it is reported, is working very satisfactorily, after a test of several years' actual service. The spherical portions are made of cast-iron and no difficulty is experienced in keeping them tight. The manufacturers are the Moran Flexible Steam Joint Company, of Louisville, Ky.

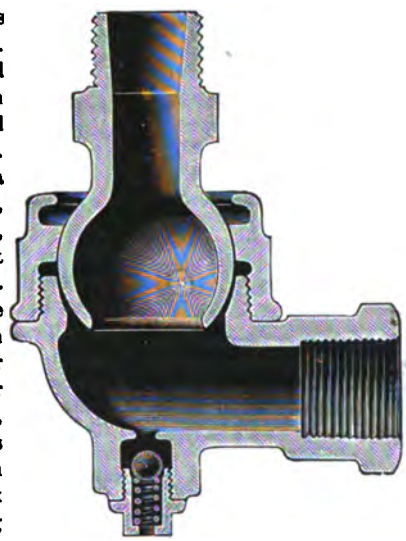

Fig. 5.

Fig. 4.

Views of Moran Flexible Steam Joint

In designing the cylinders of these engines care was taken to keep the steam pipes separate from the exhaust pipes, so as to avoid the cooling effect of the latter on the live steam. Ample provision was also made for draining both the steam and exhaust pipes. A cock is connected with the operating mechanism of the cylinder cocks, so that before the latter are opened the steam pipe can be drained, and it is kept open as long as the cylinder cocks are.

The driving springs as shown by the diagrammatic view are underhung, the firebox being on top of the frames. Liberal sized steps are provided on both the engine and tender, with very conveniently located handholds on both. The arrangement of throttle lever is a little peculiar. As will be seen from the diagrammatic view, there is the usual throttle lever back of the firebox. As the engineer occupies a position on the side, it is desirable to have the lever farther forward. A horizontal shaft, shown in the diagram, is therefore placed on the top of the firebox, which has a vertical arm located in the transverse center of the engine, and is connected with the throttle lever by a rod. On the outer end of the shaft there is a pendent lever, with a cranked handle or the engineer.

The appearance of these engines is very impressive. As shown in the diagram, the centers of the boilers are 107½ inches above the rails. They are of large diameter, so that the body of the machine is high and the Belpaire firebox adds to the massiveness of its appearance. The engines have been doing excellent service and reflect much credit on the designer. As mentioned in our first article, they weigh 134,500 pounds, and carry 185 pounds of steam pressure per square inch.

*(To be continued.)*