

## Care and Operation of New York Air-Pump, Duplex No. 2.

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The air-pump being one of the most important parts of the air-brake equipment on any train, and there being but one usually applied to a locomotive, renders it important that this particular piece of machinery receive proper care, whether on the road attached to a train, or at a terminal in the hands of hostler or round-house men, this applying to air-pumps of any particular build or kind.

The New York Duplex Air-Pump, No. 2, does not differ materially from the duplex air-pumps Nos. 1, 5 or 6, each differing only in size of cylinder and size and location of valves; therefore the description, care and operation of one will in general apply to all of those above mentioned.

### DESCRIPTION AND BUILD.

The Duplex air-pump No. 2, is constructed with four cylinders, the two upper being air cylinders, and the two lower steam, while the right steam and air cylinders are commonly titled low-pressure, and the left side steam and air cylinder high-pressure. These particular terms, no doubt, convey the idea to some that this is a compound pump, which uses its steam compound; but such is not the case, as the steam cylinders operate as simple engines, the right slide valves controlling the movement of the left piston, and the left slide valves controlling the right piston, each receiving their steam direct from the boiler, and exhausting direct to the atmosphere, which will be noticed by the following description:

Considering the air-pump to be at a standstill, with its steam throttle valve

shut off, the law of gravity would naturally cause the pistons and slide valves to fall to their lowest point of contact. Accepting this to be the position of the pump at rest, we will first describe the up-stroke. When the air-pump throttle valve is first opened, steam passes over the left slide valve direct to the under face of the right, or low-pressure piston, forcing it upward, and at the same time steam passes over the right slide valve, and is conveyed through suitable port-opening to the upper end of the high-pressure cylinder, thus holding down the left piston until the right piston has nearly completed its stroke, when a reversing plate studded to the under face of the piston engages a button on the upper end of the right reversing rod, raising it upward, and with it the right slide valve, as the reversing rod and slide valve are attached together.

The right slide valve being raised, allows steam to be exhausted from the upper end of the left cylinder, past the exhaust cavity of the right valve to the atmosphere, and at the same time opens the lower admission port under the same valve, which steam forces the left piston upward until it nearly reaches the upper limit of its stroke, when it reverses the left slide valve, the same as was done by the right. The left slide valve having been raised, connects the exhaust from the lower end of the right cylinder, allowing its steam to escape past the exhaust cavity of the left slide valve to the atmosphere, and at the same time opens the admission port under the left slide valve, which steam is conveyed to the upper end of the right piston, forcing it down until

the reversing plate engages a shoulder on the lower end of the reversing rod, forcing it down, and with it the right slide valve, which, in this case, opens the exhaust to the lower end of the left cylinder, and the upper admission forcing down the left piston to the position where the pump was first started.

In brief, it might be stated that the right slide valve controls the movement of the left piston, and the left slide valve controls the movement of the right piston, and at no time are both pistons in motion at the same time.

The air pistons being directly connected with the steam pistons, both mounted on the same rod, one operating directly over the other. The right, or low-pressure piston, makes its first stroke upward, receiving air in the lower end of its cylinder past the lower receiving valve, and discharging air from the upper end over to the high-pressure cylinder past the upper intermediate discharge valve. Then the high-pressure piston moves upward recompressing the air in the upper end of its cylinder, forcing it past the upper final discharge valve to the main reservoir, and at the same time receiving air in the lower end of its cylinder past the lower receiving and lower intermediate discharge valves. Thus we have both pistons at the upper end of their stroke, and about one atmosphere in the lower end of each cylinder, and when the low-pressure piston now moves downward it forces its volume of air past the lower intermediate discharge valve to the high-pressure piston, and receives a volume of air in the upper end of its cylinder past the upper receiving valve. The high-pressure piston then comes down and recompresses its air in the lower end, forcing it past the lower final discharge valve to the main reservoir, and receives air in the upper end of its cylinder, past the upper receiving

and intermediate discharge valves. In brief, both cylinders receive free air from the atmosphere each stroke, and as the low-pressure cylinder is double the capacity of the high, it will be observed that the low-pressure cylinder only handles one atmosphere at any time; its work remaining constantly the same, while the high-pressure cylinder handles three volumes each stroke, and recompresses against an increasing main reservoir pressure.

Care should be taken in starting the pump, first, to see that all oil-cups are filled, the drain-cocks opened, and the piston swabs well oiled. Then turn on the steam slowly, so as to heat the steam-pipe, pump-governor and steam cylinders, working out all condensation before the pump is started into more hasty speed.

Care should also be taken to know that at least twenty or twenty-five pounds of air is stored in the main reservoir before the pump is caused to run very fast, as no cushion is provided for the air or steam pistons except by storage of pressure in the main reservoir for the high-pressure side and storage of air in the high-pressure air cylinder, to protect the low-pressure side.

After starting the pump carefully, and working out the condensation, the drain-cocks should be closed, and the pump hastened into action, being careful not to race the air-pump by running it too fast.

The troubles experienced by this class of air-pump are confined to few; whether they result in partial or total failure, and no doubt more than 90 per cent of the troubles are traceable to the air-pump at some time having been run too fast, causing unnecessary heat, followed with valves sticking open or shut, and in nearly every instance gives forewarning of trouble by unusual lameness, caused by one or both of the

pistons making more rapid strokes in one direction than in the opposite, and in several cases causes a heavy pound every alternate stroke.

In such cases excitement should not overcome the better judgment of the man in charge; good reasoning should be applied, and the speed of the pump reduced, although it may not support maximum pressure. The prime object in all such cases should be to land the train to a terminal, if such can be done with safety, and there have the pump repaired. If, under such circumstances, excitement prevails, and the air-pump hastened in speed in an effort to support maximum pressure, it would be much like increasing the task of a sick man, instead of lessening his labor and nursing him to health again.

In nearly all such cases as these described the trouble with the air-valves sticking open or shut because of being gummed with dirt or oil, and in some cases caused only through heated metal causing the valves to stick, or their

cages becoming loose and getting out of place, renders it important that an air-pump should never be raced, nor allowed to work so fast that the exhaust beats can not easily be counted, each exhaust representing a single stroke of each piston.

Should an air-valve become stuck, and prevent the receiving of air at one end of one or both cylinders, it is evident that the piston or pistons must travel idly in one direction, and if traveling in a partial vacuum, must act as a pneumatic hammer, and cause severe pounding, and to reduce the speed would lessen the danger of breaking a reversing-rod or piston-rod, or otherwise causing a complete failure, but would also tend to cool the air-pump, and again get it to operate all right. And since this is a good remedy for an air-pump when in a disordered condition, it should be good treatment for air-pumps at all times, and in all kinds of service.

## Promotions and Changes.

Mr. A. J. Davidson succeeds R. C. Duff as president of the Beaumont, Sour Lake & Western Railway.

J. F. Simms is appointed Superintendent of the Ozark Division, with office at Memphis, Tenn., vice H. H. Brown, transferred, effective April 17th.

R. S. Torrington is appointed District Passenger Agent, with headquarters at Detroit, Mich., vice F. B. Gilmer, resigned, effective April 1st.

H. H. Brown is appointed Superintendent of the Eastern Division, with office at Springfield, Mo., vice A. O'Hara,

given an extended leave of absence, effective April 17th.

S. S. Butler is appointed General Agent, with headquarters at 512 Garrison avenue, Fort Smith, Ark., vice J. L. Reinach, deceased, effective April 27th.

George F. MacGregor, formerly agent at Memphis, Tenn., is appointed Freight Claim Agent, with headquarters at St. Louis. He fills the vacancy caused by the death of J. E. Leith. Mr. MacGregor has been connected with the Frisco in various capacities for the last twenty-three years.

*After you hit the ball do not forget that you are expected to make first base*

## Care of the Fire-Box.

P. W. GOOCH.

There is possibly no other one part of a steam locomotive that requires so close attention or requires more repairs, and is so essential to be kept in good order, as the immediate parts of the "fire-box," and the parts that are joined thereto.

The fire-box, too, is now, and has been for a long time, the greatest center of interest to the builder of locomotives, and many have spent long and serious study on the subject in order, if possible, to bring out something that will reduce to a minimum the dangers attendant, the strains and unequal pressures to prevent, and last, but by no means the least, to produce a box in which to secure more perfectly the thorough combustion of the fuels used and obtain a greater number of pounds of water evaporated or condensed to the pound of fuel consumed.

This is a subject worthy of the best mechanician's attention, and that also of our officials in the mechanical department.

It has repeatedly been proven by experimental test that when an engine is working hard and the fire-box temperature is 2,700 to 3,000 degrees, that the circulation in the parts around the fire-box in all the various styles of American-built engines is so poor that there is actually a space of from  $\frac{1}{4}$ " to  $\frac{1}{2}$ " next to the sheets of the fire-box that is filled with the superheated steam, and which, for lack of proper circulation, keeps the water away from the sheets while the fire is thus retained at such a high temperature.

This accounts for the unusual heating of the sheets, large expansion of the parts and the direct cause of "fire-cracks," broken staybolts, and the many

other common ills, besides a loss of fuel, increased repairs resulting in loss of the power while in the shops, and the increased danger to the lives of employes in the resultant explosions which result.

All this could be largely relieved by some means of getting good rapid circulation around the fire-box when steaming hard on grades and at all times.

This has been seen and recognized throughout the railroad world, and in all nations there is an evidence of this by the various mechanics devising various means to bring about the one result, viz.: To obtain throughout the boiler a rapid and thorough circulation, and at the same time to prevent the "priming" which is caused in hard service by the rapid circulation waters releasing the steam when reaching the surface.

In the modern American locomotive being built today, the constructors have given double the width of the space around the sides of the fire-box in order to first get a longer staybolt, which will have as a resultant more "spring." Second, a larger space in which to obtain better circulation.

This has done a great deal to relieve the common ills, but yet they are far from the desired result.

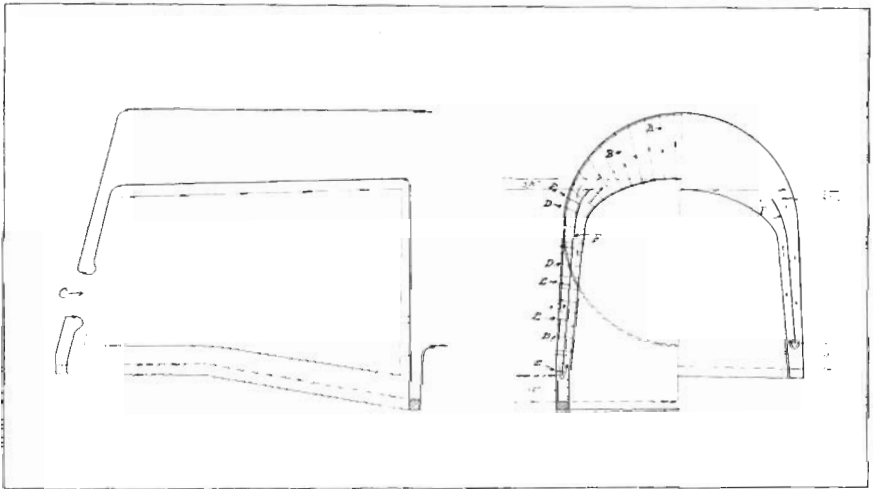
When an engine is working on high duty the sheets of the fire-box get very much heated and expand, while the shell, or outside sheets, remain practically the same temperature so long as the pressure is maintained at a given pressure. So you see the expansion and contraction of the parts are greatly different, and many unequal strains are set up at each change of "fire-box tem-

perature," with the many broken staybolts and other troubles attendant.

Now, my suggestion as a remedy for this is along lines that are identical, but was applied in a set of stationary boilers, where a forced draft was used, and the temperature in fire-box sometimes reached 3,500 degrees.

The experiment was a decided success, and has given more than our most sanguine expectations. To say it was a success is putting it too mild, for it is still largely used in that district, and

space is about 5". A plate of steel, F, is so bent that it conforms to the contour of the fire-box, and extends from about 3" from below top horizontal line of crown-sheet to within 12" of the bottom of leg. The fire-box staybolts pass through this sheet, F, through holes  $\frac{1}{4}$ " larger in diameter than the staybolt, in order not to cause any binding. The sheet, F, is held by a sufficient number of staybolts independent of others to the outside sheet, and hence expands and contracts with outside sheet, and



End and Side Elevation of Fire-box.

all new power is being so equipped. Both the repair and fuel bills are greatly reduced, and "life" added to the boiler.

In the accompanying sketch you will note a view of the rear end of a fire-box of a locomotive with boiler-head removed, showing Radical and Crown-sheet Stays, BB; C, door; DD, fire-box staybolts, etc.; E, E, E, E, "circulating plate staybolts," and F, F, "circulating plate." A rough sketch which will, however, suffice to explain.

In the legs of modern boilers the

does not hinder inside sheet or staybolts at all.

This sheet extends the entire length of the fire-box, and on both sides, and along head-width of box, and same height as the sheets on sides.

The object of these sheets are, as the sheet is held rigidly in the center of the space, that as heat is gathered in the water next to the fire-box, the steam and heat immediately rises and causes the water in outside space to descend and go under lower edge of plate, and rise to take place of the heated water,