

THE PENNSYLVANIA RAILROAD

NO. 99-C-1

BRAKE AND TRAIN AIR SIGNAL

INSTRUCTIONS

(Superseding No. 99-B-1, dated May 22, 1928)

PHILADELPHIA, PA.

AUGUST 14, 1944

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NOTICE

The instructions set forth herein apply to supervision, operation and maintenance of air brake and train air signal equipment on the Pennsylvania Railroad, and must be observed by all employees whose duties are in any way affected thereby. They supersede all previous rules and instructions inconsistent therewith.

Each employe must have a copy of this book with him when attending periodical instruction classes.

If it is necessary to modify or amplify these rules to meet any special condition on any Division, the subject must be taken up with the General Superintendent of Motive Power. Any modification or amplification must have the approval of the Chief of Motive Power.

H. T. Frushour,

General Manager, New York Zone.

W. C. Higginbottom,

General Manager, Eastern Region.

J. C. White,

General Manager, Central Region.

H. L. Nancarrow,

General Manager, Western Region.

F. G. Grimshaw,

Works Manager, Altoona Works.

Approved: H. W. JONES,
Chief of Motive Power.

OPERATION AND MAINTENANCE BRAKE AND TRAIN AIR SIGNAL

Essential Parts

1. THE BRAKE (See Figs. 1, 2 and 3).

- (a) The Compressor, which produces the air pressure.**
- (b) The Compressor Governor, which controls the Main Reservoir pressure.**
- (c) The Steam Throttle Valve, which controls the speed of the Compressor.**
- (d) Main Reservoirs, in which the compressed air is stored.**
- (e) Main Reservoir Safety Valve, which prevents excessive pressure accumulating in Main Reservoirs.**
- (f) After Cooler, which cools the compressed air before it passes to the brake system.**
- (g) Automatic Drain Valve, which automatically drains condensation from the stored compressed air.**
- (h) The Automatic Brake Valve, which controls the exhaust of air from and the admission of air to the brake pipe, to apply and release the brakes.**
- (i) The Double Heading Cock, which provides the means to cut out the BRAKE VALVE on all except the leading locomotive when two or more locomotives are in the same train.**
- (j) Emergency Relay Vent Valve, which makes possible obtaining an emergency brake application at**

any time, when the brake system is charged, irrespective of the position of the Double Heading Cock.

- (k) The Brake Pipe Vent Valve, which propagates emergency brake pipe reductions when desired.
- (l) The Feed Valve, which controls the pressure in the brake pipe and maintains it at a predetermined pressure.
- (m) The Independent Brake Valve, which applies and releases locomotive and tender brakes independently of the train brakes.
- (n) The Reducing Valve, which reduces Main Reservoir pressure to the proper amount for the Independent Brake, the Train Air Signal, and on equipped steam locomotives, for the Cab Signal Magnet Valve.
- (o) The Distributing Valve with Double Chamber Reservoir, which applies and releases locomotive and tender brakes directly and through Relay Valves.
- (p) Relay Valves, used on locomotives which are equipped with a large number of brake cylinders. They relay the application and release operation of the Distributing Valve and provide for direct flow of Main Reservoir air to the brake cylinders under control of the Distributing Valve.
- (q) The Quick Service Valve, which propagates quick service by making a brake pipe reduction on each car so equipped.
- (r) Triple Valves and Control Valves, which charge the reservoirs, apply and release the brakes.

“P2” and “K” triple valves are used with auxiliary reservoirs.

“L” triple valves are used with auxiliary and supplementary reservoirs.

“U-12” Control Valves are used with auxiliary, service, and emergency reservoirs.

“D-22” Control Valves are used with displacement, auxiliary, emergency, and supply reservoirs.

“AB” valves are used with auxiliary, and emergency reservoirs. Fig. 11.

- (s) Brake Cylinders with Pistons connected to the brake levers.
- (t) Safety Valve, for reducing brake cylinder pressure when it exceeds a predetermined amount.
- (u) Conductor's Valve, placed in all passenger carrying cars, for applying brakes from the train when necessary. Some cars have a Brake Application Valve operated by the Conductor's Valve to accomplish the same purpose. Cabin cars, also are equipped with Conductor's Valves.
- (v) The Brake Pipe, including Branch Pipe, Angle Cocks or Brake Pipe End Cocks, Cut-out Cocks, Centrifugal Dirt Collectors, Strainers, Hose and Hose Couplings.
- (w) The Pressure Retaining Valve, found on all freight and cabin cars, and some passenger and Pullman cars. Used to retain brake cylinder pressure when desired.
- (x) Air Gauges on locomotives and cabin cars which indicate the amount of air pressure being maintained.

1-A THE TRAIN AIR SIGNAL (See Fig. 1 and 2).

- (y) Signal Valve**, which operates to cause the Signal Whistle to give audible sounds in the cab of the locomotive.
- (z) The Signal Pipe**, including Car Discharge Valve, Combined Strainer and Check Valve, Stop Cocks, Cut-out Cocks, Hose and Hose Couplings.

GENERAL INSTRUCTIONS

Standard Air Pressures

2. PASSENGER LOCOMOTIVES:

Main Reservoir—Single Top Governor	-	130 pounds
Main Reservoir—Electric Locomotives	125-140 pounds	
Main Reservoir Safety Valve	- - - -	150 pounds
Brake Pipe	- - - - -	110 pounds
Safety Valve, ET Equipment	- - - -	68 pounds
Reducing Valve for independent brake and train air signal	- - - - -	45 pounds

2-a FREIGHT LOCOMOTIVES:

Main Reservoir—Single Top Governor	-	100 pounds
Double Top Governor, Low		100 pounds
High		130 pounds
Main Reservoir—Electric Locomotives	125-140 pounds	
Main Reservoir Safety Valve	- - - -	150 pounds
Safety Valve, ET Equipment	- - - -	68 pounds
Reducing Valve for independent brake and train air signal	- - - - -	45 pounds
Brake Pipe by special instructions for heavy grades	- - - - -	95-100 pounds
Brake Pipe on grades where retainers are used, other than specified heavy grades, see time-table instructions.		

The brake pipe pressure must be that specified in the Timetable for freight trains of loaded cars before descending grades; and the engineman must operate the

air brake in such a manner as to maintain a brake pipe pressure of not less than 70 pounds at all times. On trains of empty cars on such grades, the brake pipe pressure must be the standard, 70 pounds.

When freight locomotives are used to haul passenger trains, the brake pipe and main reservoir pressures must be increased to the standards for passenger locomotives **before** the locomotive is coupled to the train. The brake valve "holding feature" may be cut out by disconnecting the "U" pipe.

2-b No. 8 or 8-A Equipment—On light engines (passenger and freight), passenger engines with train, and freight engines with trains of not more than 25 cars, the controlled emergency cock must be in non-control (P) position.

2-c Air Gauges—When one duplex gauge is used, one hand indicates equalizing reservoir pressure and the other main reservoir pressure. When two gauges are used, one should be a 5" duplex gauge, showing equalizing reservoir and main reservoir pressures, and one 3½" duplex gauge, showing brake pipe and brake cylinder pressures.

2-d Cars—

Governor—water raising system	60 pounds
Reducing Valve—water raising system	20 pounds
Safety Valve—All brake equipments except HSC	58-62 pounds
Safety Valve—HSC equipment	75 pounds

3. Signals—Engine Whistle: (Operating Rule 14.)

Apply brakes, Stop	- - - - -	0
Release brakes, Proceed	- - - - -	— —
Inspect brake pipe for leak, brakes sticking and dragging equipment	- - - - -	0 —

3-A. SIGNALS—Communicating: (Operating Rule 16.)

When standing—Apply or release air brakes o o o o

When running—Brakes sticking, look back

for hand signals - - - - -

A Car Discharge Valve is usually located at each end of a passenger carrying car, in the vestibule above the door. A branch pipe extends from the main signal pipe to the car discharge valve; it is provided with a cut-out cock by means of which the discharge valve may be cut out.

4. TRAINS LEAVING TERMINAL POINTS—Percentage of Air Brakes: Each train must have the air brakes on all cars in effective operating condition, except in case of (*) emergency when authorized by the Superintendent, but at no time shall the number of operative air brakes be less than 85%.

(*) In such case of emergency where it is necessary to dispatch a car from a terminal point with inoperative air brakes, such car must be placed between the cars with operative air brakes controlled by the engineman and cabin car, and the air brake must be cut out on the cabin car.

Tenders detached from locomotives, or any vehicle equipped with brake pipe only, must be placed immediately ahead of the cabin car and brakes cut in on cabin car.

When necessary to cut out the brakes on cars in transit, care must be taken to see that no two cars with defective air brakes are in consecutive order.

The word "car" means all cars or dead engines in a train. The tender of a steam locomotive, or one unit of an electric locomotive, will be counted as a car. A car having the brake cut out on one truck must be counted

as a non-air car in determining whether the train has the required percentage of air brakes operative. (Also see Instructions 8-b, 15-b and 30.)

The following table may be used to determine how many cars will be allowed in the trains with inoperative air brakes in order to maintain the required 85%.

Number of Cars in Train	Maximum Number of Cars Allowed Without Operative Air Brakes
6 cars or less	0
7 " to 13 cars inclusive	1
14 " " 19 " "	2
20 " " 26 " "	3
27 " " 33 " "	4
34 " " 39 " "	5
40 " " 46 " "	6
47 " " 53 " "	7
54 " " 59 " "	8
60 " " 66 " "	9
67 " " 73 " "	10
74 " " 79 " "	11
80 " " 86 " "	12
87 " " 93 " "	13
94 " " 99 " "	14
100 " " 106 " "	15
107 " " 113 " "	16
114 " " 119 " "	17
120 " " 126 " "	18
127 " " 133 " "	19
134 " " 139 " "	20
140 " " 146 " "	21

5. TO MAKE UP A TRAIN:

Passenger—Connect the brake pipe and signal pipe by uniting the couplings A and M (Figs. 2 & 3) with the corresponding couplings on the next car. Turn the angle cock B or brake pipe end cock C slowly in line with the hose, and cut-out cock handle L slowly to a position crosswise of the pipe, thus opening the angle cock or brake pipe end cock and cut-out cock. Always turn the angle cock or end cock nearest the locomotive

first, and the signal line cut-out cock nearest the locomotive last. Then see that cut-out cock handle H is crosswise of pipe, that release valve is closed, and that all hand brakes are released. If a car is equipped with a pressure retaining valve, it must be in released position (handle pointing downward).

Trains equipped with HSC equipment have another pipe, known as the Straight Air Pipe, which must be coupled as well as the brake pipe and signal pipe and the cocks opened. Fig. 2.

5-a. Freight Cars in a Passenger Train—Freight cars to be operated either permanently or temporarily in passenger train service, the brake cylinder or its pipe should be equipped with a safety valve adjusted to close at approximately 60 pounds. In emergency cases, cars may be operated without this safety valve and the engineman in charge of the train notified to operate the train brakes under normal conditions in such a manner as to avoid a service brake cylinder pressure in excess of 60 pounds at speeds less than 25 miles per hour. Freight cars, equipped with AB-1B brake, can be hauled in passenger trains without any changes or adjustments.

Freight cars equipped for passenger train service should have AB-1-B brake equipment with retaining valve, steel wheels, steam heat line and air signal line.

On account of braking arrangement, when passenger trains have class X-29, or other types of freight cars equipped for passenger train service, they must have passenger equipment cars in proportion to freight cars, not less than:

1 passenger to 1 freight, when lading is between 25,000 and 50,000 pounds.

2 passenger to 1 freight, when lading is between 50,- and 75,000 pounds.

3 passenger to 1 freight, when lading is between 75,000 and 100,000 pounds.

For two such passenger equipped freight cars, the lading of which is less than 25,000 pounds each, one regular passenger equipment car must be included in the make-up of the train.

1 empty passenger equipped freight car to equal 1 passenger car.

The weight of lading in a car in express service loaded with mixed freight normally does not exceed 25,000 pounds—occasional carload shipments exceed 50,000 pounds, in which case the weight should be ascertained from the Railway Express Agent.

When the make-up of a passenger train is such that the number of allowable loaded freight cars exceeds the limit above prescribed, the train must be operated under the regulations and speed restrictions which apply to freight trains, as well as the use of retaining valves on grades.

5-b. Freight—Connect the brake pipe by uniting coupling A (Fig. 4) with the corresponding coupling on the next car. Turn the angle cock handle B, or the brake pipe end cock slowly in line with the hose, and lock it, thus opening the cock, turn the angle cock or end cock on or nearest the locomotive first. Then see that cut-out cock handle H is crosswise of the pipe; that the handle of the pressure retaining valve is in release position and hand brakes are released.

In order to avoid stuck air brakes on freight trains where yard or helper engines couple or make up and couple the rear portion of train; when the rear portion of train has been assembled and placed against the front

portion, the trainman after making the coupling, and the rear portion of the train has been stretched, before coupling the hose, will signal the engineman on the helper or yard engine to apply the brake, the engineman will make a 20-pound brake pipe reduction and then turn the double heading cock to the No. 2 position and place his brake valve handle in running position. After the trainman has noted the brakes are applied on the rear portion which is being handled by the helper or yard engine, he will couple the air hose and open the angle cocks; the road engineman can then proceed to make the proper test of the brakes.

5-c. (Passenger Cars in a Freight Train)—A passenger car, or any other type of car equipped with a passenger car brake, when operated in a freight train, should be coupled as in the preceding paragraphs but it must have the graduated release feature set for direct release, and the air supply to the water raising system cut out if the train consists of more than 30 cars. When cars are returned to passenger service, the graduated release feature must be set for graduated release and the air supply to the water raising system cut in.

5-d. (Troop Trains—Mixed Passenger and Freight Equipment)—Troop trains should be prepared at point of origin to run through to destination. The brake equipment should be “in date” and in proper operating condition; brake shoes should be new or of sufficient thickness to complete trip to final destination. Slack adjusters should be adjusted to provide maximum take-up before requiring adjustment, and piston travel should be not more or less than nominal.

Passenger equipment cars having graduated release feature, must have the graduated release cap in direct

release position if the train consists of more than 30 cars.

In mixed trains the passenger equipment cars should be hauled next to the locomotive, in cold weather, in order to heat the water raising system, otherwise the system must be cut out and drained.

Mixed trains should be operated at freight speed and with freight train air pressure.

Trains of all passenger equipment should not exceed 30 cars.

5-e. (Dead Locomotives in a Freight Train)—A dead locomotive in a freight train should be coupled the same as a freight car.

Locomotives with ET No. 6 brake equipment moved dead, must have a Quick Action Cylinder Cap on the distributing valve, or a Brake Pipe Vent Valve on the tender.

Locomotives with ET No. 8 brake equipment moved dead, must have a Brake Pipe Vent Valve on the tender.

Locomotives with A-1 brake equipment must have the double heading cock closed.

Locomotives with ET No. 6 brake equipment and dead engine feature must have the double heading cock closed, and dead engine cock open.

Locomotives with ET No. 6 brake equipment without dead engine feature, the double heading cock must be open, the tension removed from the feed valve adjusting spring, the brake pipe exhaust blanked by applying a pipe plug in the brake pipe exhaust port in the double heading cock, and the rotary valve secured to its seat by use of a standard air hose coupler gasket applied to the top of the rotary key gasket.

Locomotives with ET No. 8 brake equipment must have the double heading cock closed and the dead engine

cap or cock changed to dead engine position. The controlled emergency cock must be in non-control position.

S-1 locomotives have D-22 brake equipment with dead engine feature. When moved dead, close double heading cock and open dead engine cock.

T-1 & S-2 locomotives have D-22 brake equipment with a dead engine cap on the D-22 valve. When moved dead, close double heading cock and change the dead engine cap to dead engine position.

On all of the above equipments, the handles of the automatic and independent brake valves must be clamped in running position, and safety valve adjusted to limit brake cylinder pressure to a maximum of 30 pounds.

Electric locomotives with double end equipment and one distributing valve, may have the brake valves in lap position (or handles off) at one end, and at the other end in running position. When two distributing valves are used, the brake valve handles on both ends must be clamped in running position. Electric locomotives, moved dead, must have dead engine cap turned to dead engine position.

5-f. After the locomotive has been coupled to the train, the couplers between the locomotive and the train, and where practicable, the entire train should be stretched to see that all couplings are made. When this is known, the engineman should apply the independent brake. Before the brake pipe hose, between the locomotive and train, has been coupled, condensation must be blown from the brake pipe by opening the angle cock or brake pipe end cock. The engineman should hold the brakes applied until the proper signal to charge the train has been received.

When the signal to charge the train has been re-

ceived, the engineman will place the automatic brake valve handle in release position on all passenger locomotives, and on freight locomotives equipped with other than M-3 feed valves, and allow it to remain there until the required pressure is obtained for a test of the brakes. The brake valve handle should then be placed in running position, and if the brake pipe pressure falls more than 5 pounds below the required pressure, the handle should be returned to release position until the required pressure is obtained. On freight locomotives equipped with M-3 feed valves, running position must be used for charging and recharging.

6. Testing Brakes—In no case will a train be started until the engineman and conductor know the condition of the brakes, the number of cars in the train and the number of brakes operative. This information may be secured from the employes personally who have inspected the train or from information shown on M.P. 261-B form, as shown in the following, and signed by the inspector making the test and given to the yardmaster or his representative for delivery to the train crew.

M.P. 261-B

4 3/4 x 3"

**INSPECTOR'S REPORT ON CONDITION OF AIR
BRAKES WHEN UNABLE TO NOTIFY CREW**

Place Yard

Track Date

Number of cars in train.....

Number of cars having inoperative brakes

Brake Pipe leakage (lbs)

.....
Inspector

6-a. In passenger service the signal for the application or re-application of the brakes may be made as in freight service (See following paragraph) or by 4 sounds of the air signal whistle, obtained by opening the car discharge valve on any car in the train. The signal for the release of the brakes will be by 4 sounds of the air signal whistle, which must be given by opening the car discharge valve on the last car from which the signal can be given.

6-b. In freight service, to first apply the brakes, or after a test has been made, should it be necessary to make additional applications of the brakes, on account of defects found while passing along the train, inspectors or trainmen shall signal the engineman as follows: A hand, flag, or lamp swung horizontally above the head. The signal for the release of brakes, when testing them, will be as follows: A hand, flag, or lamp held at arms length above the head.

Attaching and Detaching Cars in a Passenger Train

7. Switching Road Train—Either Setting Off or Adding Cars—All switching of cars should be controlled by the air brake and in no case should switching or road movements be made unless the brake system is charged to at least 70 pounds.

Originating Terminal Train Brake Tests

8. Foremen of Inspectors and Inspectors are jointly responsible for the condition of the air brake and train air signal equipment on cars leaving their station.

8-a. The train air signal system on passenger carrying trains shall be tested and known to be in suitable condition for service.

8-b. Each train must have the air brakes on all cars in effective operating condition, except in case of emergency, but at no time shall the number of operative air brakes be less than 85%, which is the Federal minimum. (See Instructions 4)

8-c. Condensation must be blown from the pipe from which air is taken before connecting yard line or locomotive to train.

8-d. The train must be charged to standard pressure, retaining valves and retaining valve pipes on freight cars inspected and known to be in suitable condition for service, and the position of angle cocks, end cocks, cut-out cocks and hose noted. A careful examination must be made for leaks and necessary repairs made to reduce leakage to a minimum. Leakage must not exceed 5 pounds per minute.

8-e. After the brake system on trains is charged to standard pressure, a 15-pound service reduction must be made upon request or proper signal, then note the number of pounds of brake pipe leakage per minute as indicated by the brake pipe gauge, after which the reduction must be increased to a total of 20 pounds. An examination of the train brakes must be made to determine if brakes are applied in service application on each car; that piston travel is correct, and that brake rigging does not bind or foul. Piston travel less than 7 inches or more than 9 inches must be adjusted to nominally 8 inches.

8-f. When this examination has been completed, a proper release signal must be given and each brake examined to see that it releases properly.

8-g. After the test is completed the inspector or

trainman who made the test will personally inform the engineman and conductor, and advise them the number of cars in train and the number having inoperative brakes. See Inst. 6.

Defects discovered during a standing test that cannot be repaired promptly must be reported to the foreman inspector or conductor for appropriate action.

During standing tests brakes must not be applied or released until proper signal is given.

8-h. When a train is tested from a yard test plant, an engineer's brake valve, or a standard testing device (see tracing E-52585 for freight and E-71035 for passenger) which provides for the increase and reduction of a brake pipe pressure at the same or a slower rate as with the engineer's brake valve, should be used and be connected to the same point in the train to which the locomotive is to be attached.

The train should be charged and tested as prescribed in preceding rules and where practical should be kept charged until the road locomotive is coupled to train, when an application and release test must be made. Trainmen or car inspectors must note that brakes apply and release on the rear car.

If a train is made up on more than one (1) track, the application and release test by the road locomotive applies to only that portion which is to be hauled next to the locomotive; the balance of train must be tested as prescribed in 10-B. ~~after the train is completely made up.~~

If brake valve or testing device is not used, or if after testing the brakes from a yard plant the train is not kept charged until the road locomotive is coupled, the brakes must be tested as prescribed inst. 10-B.

8-i. Before adjusting piston travel or working on brake rigging, the cut-out cock in branch pipe must

be closed, and reservoirs drained. On cars equipped with cut-out cock in the brake cylinder pipe, the latter only need be closed.

Inter-Terminal Yard Limit Brake Tests

9. Freight cars moved in train or draft from one yard to another or to delivery tracks and freight stations over or across main tracks within terminal yard limits, must have the air brake hose coupled between all cars, and after the brake system is charged within 5 lbs. of the standard air pressure, a 15-pound service reduction must be made. Then an examination of the train brakes must be made to determine if the brakes are applied in service application on each car. The trainmen must know that all air and hand brakes are released, before the train is started or while passing them immediately after starting to avoid damage to wheels.

Trains dispatched for movement outside of terminal yard limits must have the brakes tested on each car as outlined in Originating Terminal Train Brake Tests.

Road or Intermediate Terminal Train Brake Tests

10. On a passenger train, before an engine is detached or an angle cock or end cock closed, except for cutting off one or more cars from the rear of train, the brake must be applied. After recoupling and opening the angle cock and before proceeding, an application and release test must be made from the engine. Inspector or trainman will note that the rear brakes apply and then signal for a release, noting that rear brakes release.

10-a On a freight train, before an engine is detached or an angle cock or end cock closed on an engine or a car, the brake must be fully applied. After recoupling and

opening the angle cock and before proceeding, it must be known that the brake pipe pressure is being restored, as indicated by the caboose gauge, and that the rear brakes are released. In the absence of a caboose gauge, a test must be made as prescribed in Inst. 10.

10-b. At points where motive power, engine crews or train crews are regularly changed, tests of the train brake system must be made as follows:

After the brake system on a freight train is charged to not less than 5 lbs. below the standard pressure for that train, and on a passenger train to at least 70 lbs., a 15-pound service reduction must be made upon proper request or signal, brake pipe leakage noted as indicated by the brake pipe gauge (which must not exceed 5 lbs. per minute), after which a further reduction must be made to make the total reduction 20 lbs. Then an examination of the train brakes must be made to determine if brakes are applied in service application on each car and locomotive tender. When this examination has been completed a proper release signal must be given and each brake examined to see that it releases properly. Retaining valves should be tested at points specified by special instructions.

At points where motive power, engine crews, or train crews are changed to meet an emergency condition, an application and release test of the brakes, as outlined in Inst. 10 or 10-a, will meet the requirements.

At intermediate terminals it will be satisfactory to make the terminal test on a passenger train when the brake system is charged to at least 70 lbs., unless "undesired quick action" has been experienced, when standard pressure should be used for testing.

In freight service, after the brake system is charged to not less than 5 lbs. below the standard pressure, the

engineman, upon receiving the proper signal, will give one blast of the locomotive whistle for brake test, (except at points where blowing the whistle is prohibited) and make a service application of the brakes, being careful to note that the brake valve discharges the proper amount of air from the brake pipe.

10-c. When one or more cars are added to a train at any point subsequent to a terminal test, the cars added, when in the position in the train where they are to be hauled, must be tested as prescribed in Inst. 10-b. Before proceeding, it must be known that the brake pressure is being restored as indicated by the caboose gauge and that the rear brakes are released. In the absence of a caboose gauge, a test must be made as prescribed in Inst. 10.

10-d. Before a train is operated down a grade requiring the use of retaining valves, it must be known they are in such condition that the speed of the train can be safely controlled by the engineman.

10-e. Whenever the locomotive is to be detached or a stop made on a heavy grade under circumstances in which the efficiency of the air brake system may be impaired by allowing the train to stand with the air brakes applied, a sufficient number of hand brakes must be set to hold the train before the air brakes are released or the engine detached. When ready to start, hand brakes must not be released until the air brake system has been fully recharged.

On electric locomotives and "MU" trains, when the current is off, or the air compressors stop working for any reason, hand brakes must be applied to secure the train, as prescribed in Inst. 15-b, when the main air reservoir pressure is reduced to 5 lbs. below the normal brake pipe pressure.

Air Brake Tests of Arriving Trains

11. Where inspectors are employed to make a general inspection of cars upon arrival at a terminal they must make a visual inspection of retaining valves and pipes, release valves and rods, brake rigging, hand brakes, hose and position of angle cocks or brake pipe end cocks, and make necessary repairs or mark for repair tracks any cars on which yard repairs cannot be made promptly.

11-a. Freight trains arriving at terminals where facilities are available and at which special instructions provide for immediate brake inspection and repairs, shall be left with air brakes fully applied. Inspection of brakes and needed repairs must be made as soon thereafter as practicable.

Running Tests

12. **Passenger Train**—After locomotive or locomotive crew has been changed or an angle cock closed, except for cutting off cars from rear, and before descending grades as called for in special instructions, a running test of brakes must be made as soon as speed of train permits. Such test should be made by applying the train brakes with sufficient force to ascertain whether they are operating properly. Steam or power should not be shut off unless conditions require it. In case the brakes do not operate properly in this test, the signal for brakes must be given. See Inst. 15-b.

12-a. **Freight Train**—Enginemen must make a running test of the train brakes at the first opportunity after leaving a terminal, and also before descending grades as called for in special instructions.

13. Failure to Maintain Required Pressure—When, from any cause, the pressure required for the safe handling of the train cannot be maintained, the train must be stopped, the engineman must immediately notify the conductor, both engineman and conductor will be held responsible for taking the necessary action to insure the safe movement of the train. See Inst. 15-a and 15-b.

Trainmen, riding in cabin cars, must make frequent observations of air brake gauges to see that brake pipe pressure is normal. If gauge indicates brake pipe pressure is not normal, arrangements must be made to stop train and ascertain cause.

14. Inoperative Air Brake (On Trains)—When the air brake becomes inoperative on a train it will proceed carefully, with hand brakes, to the first point of communication where the Conductor will report to the Superintendent for orders.

14-a. (On Locomotives)—All locomotives must leave terminal points with the air brakes in serviceable condition. If a failure of locomotive brakes occurs between terminals, report must be made to the Superintendent, at first point of communication, who will issue instructions as to disposition of the locomotive.

15. Hand Brakes—All trains must be controlled by the air brakes. If, after leaving terminal, a condition arises which makes the use of hand brakes necessary, the engineman will sound engine whistle signal. (Operating Rule 14-a.) See Instructions 14, 15-a, 15-b and 29.

15-a. (Freight Trains)—One short blast of the locomotive whistle will signify that hand brakes must be applied to supplement the air brakes. Continuous calling

for brakes will signify "No Air," in which event the angle cock or brake pipe end cock at the rear of the train must be opened and the hand brakes must be promptly applied on all cars until the train has been stopped. Engineman and conductor must then agree as to the method in which the train is to be handled, to insure safe operation to the next point of communication, before the train proceeds.

15-b. (Passenger Trains)—One short blast of the locomotive whistle will be a signal by the engineman that the brakes cannot be operated from the locomotive. Trainmen should immediately open the conductor's valve (see Instruction No. 32), and the hand brakes must at once be applied on all cars until the train has been stopped. Engineman and conductor must then agree as to the method in which the train is to be handled, to insure safe operation to the next point of communication, before the train proceeds. (See Instruction No. 14.)

When a locomotive is detached from a train, whether purposely or accidentally, or the air brakes become inoperative on grades, trainmen must be governed as follows:

On ascending grades promptly apply the hand brakes on each car, beginning with the rear car in train, and if necessary, block the wheels. On descending grades, trains must be secured in the same manner, beginning with the first car in the train. If blocking has been used it must not be removed, nor must the hand brakes be released until after the road train brake test has been made.

A car having the hand brakes inoperative must never be the rear car of a train.

A car having the air brake inoperative, may however,

be the rear car in a freight train but not in a passenger train without orders from the Division Superintendent.

A car having an inoperative air brake must never be the first car in a passenger train, when two or more locomotives are in charge, unless car is equipped with UC or D-22 equipment and brake cut out at brake cylinder cut-out cock only, or the tender of the locomotive next to the train is equipped with brake pipe vent valve. (See instructions 4, 8-B and 30)

16. Pressure Retaining Valve—This valve, placed on the end or side of freight cars near the hand brake wheel, must be used on grades where it is necessary to hold the brakes applied while recharging auxiliary reservoirs and to hold the slack of the train when operating conditions require. It is connected to the exhaust port of the triple or AB valve and some U-12 valves and through it the air is exhausted from the brake cylinder when the brakes are released.

There are three types in use on freight cars, one having two positions, one with three positions and the other with four positions. With the handles of the three types in vertical position the exhaust port is fully open and no pressure is retained. On the two-position with the handle in horizontal position 15 lbs. pressure is retained; on the three and four position, with the handle midway between vertical and horizontal, 20 lbs. pressure is retained, and in a horizontal position 10 lbs. pressure is retained. The four position retaining valve with the handle at 45 degrees above horizontal will slowly release all brake cylinder pressure; approximately 110 seconds is required to fully release 50 lbs. cylinder pressure.

Some passenger equipment cars are equipped with two position retaining valves.

The grades, the number of retainers and the position in which they are to be placed shall be specified in time-tables of the divisions on which the use of retaining valves is necessary. Conductors must know that retaining valves are properly used.

Trainmen will set these valves for use when necessary and must change them back to vertical position as soon as their use is no longer required.

17. Train Dragging—If the train is found to be dragging on account of the brakes being slightly applied, the engineman must make an effort to release the brakes, which may be done by the following method:

Make a service application and release in the usual manner.

If the brakes cannot be released as outlined, the train must be stopped and the trainmen notified to examine the angle cocks and brake pipe and cocks, hand brakes, and retaining valves.

In passenger service, one long sound of the air signal whistle is a signal from the conductor to the engineman that the brakes are sticking. The engineman will answer by two short blasts of the locomotive whistle, after which the conductor will repeat the signal. The engineman should then proceed as above.

18. Air Compressors—Before starting, see that all drain cocks are open.

Always run a compressor, when starting, slowly until all condensation is blown from the cylinders, it is warm and about 30 lbs. pressure is obtained to cushion the pistons, after which close the drain cocks. The speed of a compressor should never exceed 130 single strokes per minute.

All drain cocks must be open when air compressors are out of service.

The hydrostatic lubricator should be in operation as soon as possible after starting the compressor so as to thoroughly lubricate the steam cylinders, at which time the oil feed should be adjusted to feed 10 or 15 drops as rapidly as possible; then regulate the feed to one to three drops per minute to each compressor, depending on the service. Always keep the lubricator in operation while compressors are running.

The air cylinders of compressors are lubricated by automatic lubricators. They must be filled before each trip at the time the hydrostatic or mechanical lubricator is filled, and with the proper grade of oil. When the type B cylinder lubricator is used, care must be taken when filling, to see that there are no leaks in the pipes and that the caps are properly tightened.

Double Heading Cocks and Helping Locomotives

19. Double Heading Cocks—For the purpose of cutting out the **brake valve** on all except the leading locomotive when two or more locomotives are in the same train.

There are three types, each in a different location in the air brake system. One, generally known as the "P.R.R. Cut-out Cock", is in the main reservoir pipe connecting to the automatic brake valve (See Fig. 5); the handle is in line with the pipe (open) or No. 1 position, when the brake valve is cut in, and crosswise of pipe (closed) or No. 2 position, when the brake valve is cut out.

Pedestal type brake valves have the brake pipe double heading cock in the back of the pedestal. The handle is parallel with the cab floor (open) when the brake valve is cut in, and raised to a vertical position (closed) when the brake valve is cut out.

On former Reading Company locomotives, now operating on Pennsylvania-Reading Seashore Lines, HH-1 locomotives 373 to 378 inclusive, and locomotives of other railroads, not equipped with pedestal type brake valves, the double heading cock is in the brake pipe connecting to the automatic brake valve. The handle is crosswise of the pipe (open) when the brake valve is cut in, and in line with the pipe (closed) when the brake valve is cut out.

19-a. Helping Locomotives—When two or more locomotives are coupled to any part of a train, and when running light over the road or through yards, coupled together, the air brake and train air signal must be connected to, and the air brakes operated from the leading locomotive in the direction of movement. The handle of the double heading cock on all locomotives, except the one from which the air brake is operated, must be placed in cut out position. On these locomotives (on which the double heading cock is closed), the handle of the brake valves must be placed in running position, and when practicable the air compressor kept running to maintain the pressure in the main reservoirs to apply the locomotive brakes, also to be prepared to assume control of the brakes in case of the failure of the air compressor, or some other part of the brake apparatus on the leading locomotive; but in no case must the handle of the double heading cock be placed in cut in position on any of the locomotives, not having control of the brakes, until the handle of the double heading cock on the locomotive having control of the brakes is placed in cut out position, or until the proper brake couplings are separated.

On all locomotives with No. 8 ET equipment, coupled to front end of train, the Controlled Emergency Cock

must be in the same position. All passenger locomotives in passenger service or running light, must have the cock in non-control (P) position at all times. Freight locomotives running light or with train of not more than 25 cars, must have the Controlled Emergency Cock in non-control (P) position. Freight locomotives with trains of more than 25 cars must have the cock in controlled (F) position. On all helping locomotives, coupled to the rear end of trains, the cock must be in non-control (P) position.

Helping locomotives detached from the rear of moving freight trains must be cut off in the following manner:

Trainman will give the helping engineman cut-off signal; after the engineman acknowledges this signal, as prescribed by Rule 14-g (Book of Rules), or hand signal, trainman will close angle cock or brake pipe end cock on cabin car, lift coupler lock on cabin car which will permit knuckle to open, leaving angle cock, end cock or cut-out cock on locomotive open. Trainman will then uncouple the air hose between cabin car and locomotive by using the hose uncoupling device. When hose is separated the brakes will apply in emergency on the helping locomotives. Care must be exercised to see that hose is not permitted to pull apart.

In case of emergency the brakes can be applied from a locomotive having the double heading cock closed, if the double heading cock is in the main reservoir pipe or in the brake valve pedestal, by moving the handle of the automatic brake valve to emergency position.

When two locomotives are coupled on the front end of a freight train on which the brake system has not been charged, the double heading cock on the locomotive next to the train must not be placed in cut out position until the brake pipe pressure reaches 60 lbs. when the

standard pressure is 70 lbs., or 80 lbs. when the brake pipe pressure, by special instructions, is 95 lbs. or more.

Operation of the ET Brake Equipment

20. To Charge the Train—See Instruction 5-f.

20-a. To Make a Service Application—Move the handle of the automatic brake valve to service position and hold there until the equalizing reservoir pressure, as indicated by the hand on equalizing reservoir gauge, has been reduced the desired amount; then move the handle to lap position.

On freight locomotives equipped with No. 8-a equipment, First Service position should be used for the initial reduction. This prevents brake pipe pressure reducing faster than the controlled equalizing reservoir reduction, thus preventing a harsh run-in of slack. In passenger service, First Service position may be used as desired.

20-b. To Hold Brakes Applied—Place the handle of the automatic brake valve on lap position after the desired reduction has been obtained.

20-c. To Make an Emergency Application—Move the handle of the automatic brake valve quickly to emergency position, where it must remain until the train stops.

20-d. To Release the Brakes—In passenger service, move the handle of the automatic brake valve to release position. In freight service, on locomotives equipped with other than M-3 feed valves, move the handle of the automatic brake valve to release position. On freight locomotives equipped with M-3 feed valves, place the independent brake valve on lap position, and move auto-

matic brake valve to running position. After train brakes are fully released, move independent brake valve to running position.

20-e. Holding Feature Eliminated—The holding feature is not maintained on locomotives in passenger service, therefore, the locomotive and tender brakes can be released when the automatic brake valve is in Release, Running or Holding position and the independent brake valve is in Running position.

20-f. To Apply the Independent Brake on Locomotive and Tender—Move the handle of the independent brake valve to either slow or quick application as desired. The release position of the independent brake valve should release locomotive and tender brakes under any and all conditions.

Enginehouse Foremen and Enginemen

21. Brake and signal equipment on locomotive and tender must be inspected and maintained in accordance with the Locomotive Maintenance Instructions.

It must be known before each trip that the brakes on locomotive and tender are in safe and suitable condition for service; that the air compressor or compressors are in condition to provide an ample supply of compressed air for the service in which the locomotive is to operate, that the devices for regulating all pressures are properly performing their functions, that the brake valves work properly in all positions, and that the water has been drained from the air brake system.

22. Locomotive Piston Travel—The piston travel on the locomotive and tender must not vary more than one (1) inch in either direction from the following dimen-

sions, except on truck mounted brake cylinders, which must not vary more than one-half ($\frac{1}{2}$) inch:

Steam Locomotive—Equalizer Driver	
Brake	5"
Steam and Electric Locomotive—Clasp	
Driver Brake	6"
Steam Locomotive—Trailer Brake	5"
Steam and Electric Locomotive—	
Truck Brake	5"
Diesel Electric Locomotives—Each Piston	2 $\frac{1}{2}$ "
Diesel Locomotives—Long Island Railroad	5"
Gas Electric Locomotives	5"
Tender Brakes Without Slack Adjusters..	6"
Tender Brakes — Truck Mounted Brake	
Cylinders	5"

Braking

23. Passenger—To avoid rough slow-downs and stops with passenger trains the slack must never be changed suddenly. The slack action resulting from brake application, sudden closing of the throttle, or placing controller on electric locomotives in "Off" position, will be most severe at low speeds. Heavy brake pipe reductions should be avoided when the train speed is low. The following practice may be followed:

The locomotive steam throttle may be open, and the controller on electric locomotives moved back to the 5th notch, when making the initial brake pipe reduction. The throttle may be closed or the controller must be placed in OFF position gradually after the brake pipe exhaust closes, and brakes have applied on the train. On electric locomotives, the controller must be placed in OFF position before the train has come to a stop.

23-a. One Brake Application Method—With the steam throttle open or power applied on electric loco-

motives, the initial brake pipe reduction may be from 8 to 12 pounds; heavier reductions may be made with short trains, with further reductions as required. The controller should be gradually placed in OFF position or the steam throttle should be gradually closed to drifting position as train speed is reduced, and neither should be fully shut off at a speed of more than 15 miles per hour.

With the controller in OFF position or the steam throttle in drifting or closed position, the initial brake pipe reduction should not be less than 6 pounds or more than 8 pounds. After the slack has adjusted, further reductions to be as required.

To insure the proper release of the train brakes, the total brake pipe reduction must be 12 pounds or more, and the brake valve handle should be placed in release position a sufficient length of time to insure a prompt release of the brakes.

To graduate the brakes off, make the first graduated release by using release or running position, and for further graduations use running and lap positions until the final release, when release position should be used and the brake valve handle returned to running position.

23-b. Two Brake Application Method—The initial brake pipe reduction should be made as in the preceding paragraphs, and the first application to be released at a speed which will allow the slack in the train to adjust itself before making the second application.

When stopping trains, it is desirable that the brake cylinder pressure should not exceed 20 pounds at the time stop is completed, thus avoiding a hard stop.

When necessary to stop a train immediately after starting, the brake valve should be placed in Service position and the throttle left open or the controller

in ON position until immediately prior to the train stopping.

Trains being pushed by a locomotive from which the brakes are controlled the stop should be made without changing the position of the steam throttle valve until the brakes are applied on all cars. The independent brake valve should be held in release position while the stop is being made.

When making coal, water, or station spot stops, handle the train as for ordinary station stop, except have the brakes fully released and the speed at about 5 miles per hour, at a point which will permit the train being stopped at the proper place with a light application of either the automatic or independent brake. Careful handling is required to avoid a sudden change of slack.

23-c. Starting—Careful handling of a locomotive is necessary to start passenger trains; all free slack must be taken gradually. When two locomotives (double header) are used, the leading locomotive will control the slack, the second locomotive will supplement after the slack has been taken. Sand should be dropped as the train is stopped to avoid slipping when starting.

Special care must be taken when starting a train double headed with two electric locomotives as power is applied on both locomotives at the same time.

When it is necessary to take slack to start, take the slack on only two or three cars, and should this fail to start the train, take the slack of the entire train, and when conditions require apply the automatic brake on train, holding the locomotive brake off with the independent brake valve, using steam until the train stops. The brake must be held applied until the steam has been exhausted from the locomotive cylinders and the

reverse gear placed in forward motion. Make sure the brakes are released and start carefully, stretching the slack slowly until the entire train is in motion.

23-d. Reporting Rough Handling to Engineman—
In all cases where the train handling is not smooth, the trainmen must, at the first opportunity, inform the engineman as to just what happened in order that he may change his manner of handling.

24. Freight Train Handling—Braking—The initial brake pipe reduction on freight trains should be 6 lbs. and after the slack in the train has adjusted, follow with further reductions; the total reduction must not be less than 15 lbs. for trains up to 80 cars, and 20 lbs. for trains of from 80 to 125 cars, except on mountain grades where retaining valves are used and special instructions govern. Brakes must not be released on train of 40 or more cars, unless the brakes on all cars can be fully released at a speed of not less than 10 miles per hour. The train brakes must never be released until the brake application is fully completed.

When stopping a train with a service application, the brake pipe exhaust should be open when the train is brought to rest.

Freight train brakes should not be released while moving under any of the following circumstances:

- A. When forward portion of train is on descending grade and rear portion on level or ascending grade.
- B. When rear portion is on curves which materially retard free movement of the rear cars.
- C. When loaded cars are in forward portion of train and empty cars in rear portion.

- D. When brake pipe leakage is excessive due to defects developing after leaving terminal point.

When making a release while drifting, locomotive brakes should be held applied until the train brakes are released.

To make a release of train brakes from a locomotive having a type C-6 brake pipe feed valve, place the automatic brake valve in release position and leave it there until the brake pipe is charged to within 5 pounds of the standard pressure, as indicated by the brake pipe gauge, then move the brake valve handle to running position, to be followed by a "kick off" made by moving the handle of the automatic brake valve from running to release position for a second and then back to running position.

24-a. Starting Freight Trains—Care must be exercised, and the steam throttle valve must not be opened, or power applied on electric locomotives, until sufficient time has been given to insure the full release of all brakes throughout the train. Approximately three (3) minutes are required to release the brakes on 100 or more cars.

With two locomotives (steam) hauling, the leading locomotive will control the slack in all cases; the engineman of the second locomotive will also open the throttle very carefully, and at points where starting is difficult, use sand carefully, when stopping, to avoid slipping when starting. On ascending grades, when starting trains with one or more helpers on the rear, after proper signal has been given from rear of train, the hauling locomotive will stretch the slack and give the whistle signal to release brakes, allowing the

throttle to remain open. When it is necessary to take slack to start trains, having one or more helping locomotives, slack will be taken from the rear; the rear engineman will open the cylinder cocks but not reverse, the helping engineman next to train will reverse and take slack.

When trains are on descending grades and having one or more helpers on the rear, after the proper signals have been transmitted and brakes released, the helping locomotives on the rear will start the train. If unable to start without taking the slack, the locomotive next to the cabin will take sufficient slack to start.

Enginemen of helping locomotives on the rear of train must know that the air brakes are released before attempting to start.

24-b. Use of Independent Brake—The independent brake valve, if properly manipulated, may be used to advantage when making stops or to reduce speed under certain conditions, but must not be used to the extent of heating driving wheel tires.

Wheel sliding and tire heating may occur if the independent brake is applied and held on followed by an automatic brake application. Care must be exercised to see that excessive brake cylinder pressure on locomotive and tender is not obtained at any time.

When stopping or retarding speed of trains the brakes must be applied and released in such a manner as to prevent shocks and injury to cars and lading.

On locomotives with No. 8 or No. 8-A brake equipment running light, or with freight trains of 25 or less cars and with the emergency controlled feature cut in (See Instruction 2-b) a quick build-up of brake cylinder pressure can be procured by placing and holding the in-

dependent brake valve handle in Quick Application position.

When it is necessary to apply the train brakes to reduce the speed of trains over bridges, the reduction in speed must be made and the locomotive and train brakes fully released before the locomotive reaches the bridge, except where Time Table special instructions permit brakes to remain applied.

25. Frequent Application and Release of Brakes—As the brakes are applied by air from the auxiliary reservoirs, frequent application and release reduces the pressure and consequently the power to apply the brakes, for, while applied, the supply to the auxiliary reservoir is cut off; therefore, after each release the handle of the brake valve must be left in charging position until the brakes are applied again, or until the required pressure is obtained in the brake pipe and auxiliary reservoirs.

26. Emergency Application, Accidental or from Train—Should the brake apply suddenly, the steam throttle or controller must be immediately closed, and the brake valve on all locomotives in the train moved to emergency position, and left there until the train has stopped. Locomotive and tender brakes must not be released with the independent brake valve until after the train has stopped.

Passenger or troop trains with cars equipped with AB or AB-1-B brakes and having 110 pounds brake pipe pressure, after an emergency brake application, two (2) minutes must elapse before trying to release brakes. All trains having 70 pounds brake pipe pressure, one and one-half (1½) minutes must elapse before trying to release an emergency application.

Enginemen must be notified, before leaving terminal, when such cars are in the train.

27. Reporting Defects—Enginemen must report at the end of each trip, on the regular form furnished for the purpose, any defects to locomotive and tender brake and signal apparatus and turn in the report to the Enginehouse Foreman.

Conductors must report, on form provided for the purpose, all defects existing in brake or signal apparatus on cars in their train. These forms must be handed, on arrival at end of trip, to Station Master, Yard Master, or Foreman of Car Inspectors.

Both engineman and conductor must report all cases of undesired quick action.

28. To Cut Off a Car or Locomotive from a Train—First—Make a full service application of the brake. Second—Turn the angle cock or brake pipe end cock handles crosswise of pipe on each side of the couplings to be separated, turning handle farthest from the locomotive first. On passenger trains, close signal line cocks by turning handles in line with pipe, and close steam heat end valves. Third—Disconnect the brake and signal hose couplings and steam connectors before the cars are uncoupled. Fourth—See that all brakes on cars or locomotives to be cut off are released.

29. Cars Standing Detached from a Locomotive—The hand brakes and not the air brakes must be applied, except as noted below.

To prevent injury to passengers, it is desirable to have the air brakes applied on all cars in trains while standing at stations where locomotives or cars must be separated for shifting movements.

30. To Cut Out a Defective Brake— To cut out a defective brake on cars equipped with triple valves, turn the cut-out cock H in the branch pipe (Fig. 4) in line with the pipe, and open auxiliary reservoir release valve K, holding it open until all the air is exhausted from the reservoir.

On cars with AB valves, close cut-out cock in branch pipe and open duplex release valve wide to drain both auxiliary and emergency reservoirs.

On cars equipped with UC or D-22 equipment, when necessary to cut out the air on account of undesired quick action or a serious leak between the branch pipe cut-out cock and the valve, turn the handles of the branch pipe and brake cylinder cut-out cocks in line with the pipes. If the air is cut out for any other defect in the brake, turn the handle of the brake cylinder cut-out cock in line with the pipe. It will not be necessary to drain the reservoirs.

On cars in freight trains, attach a Defective Air Brake Card, M. P. 276, in accordance with directions in Instructions No. 40.

When it is necessary to place a car, on which the air brakes cannot be used, on the rear of a train, the brake hose coupling must be united with that on the car in front, and the angle cocks (except that on the rear of the train) left open so that the air can pass into the brake pipe of the rear car when this pipe is in good condition. When the brake pipe is not in good condition, the angle cock on the forward end of rear car must be closed and both engineman and conductor notified. (See Inst. 4, 8-B and 15b)

31. Releasing Brakes By Means of Release Valve—

On cars having a release valve on the auxiliary reservoir, open release valve K (Fig. 4), and hold it open until the air starts to escape from the triple or control valve exhaust port or retaining valve exhaust port, when it must be immediately closed.

Cars equipped with AB and D-22 valves have a duplex release valve attached to the service portion of the valve, by means of which the auxiliary reservoir air may be drained alone or both auxiliary and emergency reservoirs may be drained at the same time.

To release a brake move the release handle only part way and the auxiliary release check will be unseated; when air starts to escape from the exhaust port or the retaining valve exhaust port, close the valve immediately. Moving the release valve handle its full travel lifts both check valves and both reservoirs are drained.

When releasing a brake in a train, the release valve should only be used after an investigation has shown that the brake cannot be released by the engineman. When releasing brakes to switch cars, release valve should be held fully open until all air pressure has been released from the reservoirs.

32. To Apply Brakes from Train—This must only be done in case of emergency, and never from the rear of the train except to avoid an accident. Trainmen must endeavor, wherever possible, to attract the engineman's attention by signalling before applying the brakes from the train, and enginemen will look back along their train for hand signals as often as it is consistent. When necessary to apply brakes from the train, either of the following may be used:

A—By opening the conductor's valve on passenger equipment and cabin cars holding it open until the train is stopped.

B—By opening the angle cock on the rear of the last car in the train by turning the handle B (Fig. 4) in line with pipe.

33. Burst Hose—In case of a burst air brake hose, turn the angle cock or brake pipe end cock handle immediately in front crosswise of pipe and signal the engineman to release brakes.

After the defective hose has been replaced, couple in the usual manner and make a road test of the brakes.

In case of a burst signal hose, turn the signal line cut-out cock handle L (Fig. 2) immediately in front in line with pipe.

34. Removal of Air Brake and Signal Hose—Trainmen or inspectors in removing defective air hose from locomotives or cars must not remove the extension nipple where applied to the angle cock. These nipples are applied in order to give the air hose the proper length and their removal may result in the hose parting. Air brake or signal hose which become defective on trains enroute must be removed and properly tagged, showing the number of the train, initials and number of car, or locomotive, which end of car, locomotive, or tender from which removed, date and place of renewal. If removed from locomotives or tenders they should be sent by the engineman to the enginehouse foreman and reported on Form M.P. 62, if from passenger equipment cars to the foreman of car inspectors at terminals; from freight cars to be delivered to first available car inspector who will furnish one to replace it. Freight conductors must carry, as part of their equipment, a supply of Form M.P. 401 and use them as directed thereon.

Note: The end of car upon which the brake shaft is

located shall be known as "B" end and the opposite end as the "A" end. If the car has two brake shafts, the respective ends, "A" and "B", are stenciled on car near each end on both sides.

The proper tagging of the hose is essential in order that the proper bill can be made against foreign roads for material applied to their cars.

In applying air hose gaskets, the groove in the hose couplings provided to receive the gaskets, must first be cleaned out. The trimming of the gasket in order to have it enter the groove is not permissible.

35. Broken Brake Pipe—In case of failure of brake pipe on passenger equipment cars or tenders, or the branch pipe to the conductor's valve, the signal line on the defective car or tender may be used to transmit brake pipe pressure to the rear cars by forcing the signal line hose coupling with the air brake hose coupling on cars adjoining the one with defective brake pipe. This change will render inoperative the air signal on the defective car and all cars following. In order to obtain a signal from cars ahead of the defective one, the signal line cut-out cock should be closed on the rear of the car immediately in front of the defective car. Before proceeding a road test of the brakes must be made.

At the point where couplings made in this manner are separated, the hose should be removed and forwarded to the shop so they can be gauged with a gauge shown on standard tracing E-61709, to determine if any damage has been done by forcing the couplings together.

36. If Train Breaks in Two—Turn the angle cock or brake pipe end cock handle crosswise of pipe on rear

end of car immediately in front of break, and signal engineman to release brakes. After the train has been re-coupled, close the angle cock or end cock on rear portion of train immediately in back of break, and test the air brake hose before charging the rear portion of train and releasing brakes. After the brake system has been fully recharged, a road test of the brakes must be made.

37. Operation of the Train Air Signal—The pull of the valve cord should be downward and only sufficiently hard to open the car discharge valve.

In order that proper sounds of the signal whistle be obtained, an exhaust of not less than one second duration, with not less than three seconds intervening between pulls on the cord, should be made. With a train of twelve or more cars, allow at least four seconds between exhausts.

A defective car discharge valve can be cut out of service by closing the cut-out cock T in signal branch pipe (Fig. 2).

38. Piston Travel Adjustment—The adjustment of the brake rigging should be such that the piston travel under full service application shall be as follows:

Standard weight passenger equipment cars	8"
Multiple unit cars	8"
MP-54 cars	5"
Gas and Diesel cars	4½"
Freight equipment cars	8"

The piston travel must not vary more than one (1) inch in either direction on the above equipment.

Light weight passenger equipment with pneumatic brake	5"
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Light weight-passenger equipment with electro-pneumatic brake 3½"

The piston travel must not vary more than one-half (½) inch in either direction on light weight equipment.

39. Repairs to Trucks—When necessary to make repairs of any character to the brake rigging, brake shoes, or any part of the truck, the cut-out cock in the branch pipe must be closed and air pressure drained from reservoirs by means of release valve.

Note—If the car is equipped with UC or D-22 equipment, turn the handle of the brake cylinder cut-out cock in line with the pipe, and do not release the air from the reservoirs. On cars with brake cylinders mounted on the truck, close the cut-out cock in the brake cylinder pipe to the truck on which repairs are to be made.

On locomotives with ET equipment, close the cut-out cocks in the supply pipe to the distributing valve and brake cylinders. On locomotives having triple valves, follow the same procedure as for cars.

40. Use of Defective Air Brake Cards—The attention of trainmen is called to the importance of using Defective Air Brake Card M. P. 276, when any defect occurs to the air brake equipment on cars in freight trains. When necessary to attach this card to a car, the particular defect must be marked off on the card for the information of the inspector.

Cars having defective air brake cards attached must be repaired at the first terminal repair point. When repairs are made, the cards should be removed by the inspector, properly filled out and forwarded to the proper authority for billing in accordance with the A. A. R. rules.

The cards should be attached to the brake pipe near the angle cock on both ends of a car.

40-a. Effects of Defects—Any defects between the cut-out cock in the branch pipe and the brake shoes will render the air brake on a car inoperative, but does not in any way interfere with the main brake pipe for use in passing the air pressure to the other cars. The air brake can be cut out of service by closing the cut-out cock in the branch pipe and opening the release valve until all the air is exhausted from the brake reservoirs. The car can be operated between air braked cars in service to the first terminal repair point; two cars so cut out should never be operated consecutively in the same train. An M. P. 276 defective air brake card must be attached.

41. Any defects in the angle cock or brake pipe end cock, main brake pipe, or branch pipe between the brake pipe and cut-out cock will render the air brake on a car inoperative, and will also prevent the use of the brake pipe to pass air through to other cars. Cars with such defects must be placed immediately ahead of the cabin car. (See Instructions 4)

42. Back Up Hose—When it is the practice to push trains in and out of stations, or through yards, or in the operation of Work Trains, the Back Up Hose must be used. This is a device connected by a standard hose coupling to the brake pipe hose, by means of which the trainman on the leading car is enabled to apply the brakes either in service or emergency applications when the handle of the automatic brake valve is in running position. It is also used to give warning of the approach of the train by means of its whistle signal.

The cut-out cock is closed when the handle (Fig. 6) is in line with the pipe.

To make a service application of the brakes, partially open the cut-out cock by turning the handle slowly toward a position crosswise of the pipe, until the desired result has been obtained, when the cock should be closed. To make an emergency application, turn the handle quickly crosswise of the pipe and hold it there until the train stops. To operate the whistle, push the button.

When cars are pushed by a locomotive, the trainman in charge of the movement must know that the air brake and train air signal are coupled through from the front of the leading car to the locomotive, and in an operative condition; that the Back Up Hose is coupled to the front end of the leading car and is in good working order. The trainman will then take a conspicuous position on the front end of the leading car and signal the engineman by using both communicating air signals and hand signals.

The engineman will control the movement in accordance with signals from the trainmen.

When necessary to stop, the trainman on the front end of the leading car will signal to the engineman by means of the communicating air signal. If the engineman does not quickly respond to this signal, the trainman will be held responsible for stopping the movement at once by opening the cut-out cock; also to stop the movement in emergencies.

The engineman shall not start the train until the signal to start, given by the communicating air signal, has been followed by a hand signal from the trainman. Cars may, however, be switched by the use of hand signals.

When the communicating air signal is inoperative, or

when a freight train or work train not equipped with train air signal is making a reverse movement, the trainmen must notify the engineman who will then be governed by hand signals only.

42-a. Back Up Valves—On streamlined observation cars, Back Up Valves are provided as part of the air brake equipment. They are located to the left of the center line of car, when facing to the rear, and are for the same purpose as the Back Up Hose. (See Fig. 2.)

43. Air Operated Water Scoop—To lower the scoop, move the handle of the water scoop air valve to “Down” position (Fig. 7) ; to raise the scoop, move the handle to “Up” position, which should be done before the end of the water trough is reached.

The water scoop air valve should be kept in “Up” position at all times except when using the scoop.

Inspection at Terminals

44. Duties of Inspectors and Repairmen—All car inspectors and repairmen whose duty it is to inspect and make light repairs to trucks and draft arrangements must also be required to give the same attention to hand brake defects, adjustment of brake rigging, brake pipe hangers, angle cocks or brake pipe end cocks hose and couplings, and pipe connections. The repairs must be made at the same time that other defects receive attention.

When necessary to remove a defective valve on an “In date” car, an M. P. 346, properly filled out, must be forwarded with the valve when sent to the Air Brake Shop for testing and necessary repairs.

45. Brake Cylinders, Triple Valves, U-12, D-22, AB,

Relay, and Quick Service Valves—Inspector must see that these parts are cleaned, lubricated, and tested not less frequently than indicated below:

Passenger Equipment

Triple and Safety Valves, Brake Cylinders,

Slack Adjusters 12 months

U-12 and D-22 Valves, Brake Cylinders,

Slack Adjusters, Relay, Quick Service

and Safety Valves 15 months

Freight Equipment

Triple Valves and Brake Cylinders 15 months

AB Valves and Brake Cylinders 36 months

The 36 month period applied to AB equipment only when the AB type of brake cylinder is used, otherwise the cleaning must be done as with triple valves.

The date on which this work is done must be stenciled on each car as follows:

Passenger Equipment

Triple valve equipped cars on the auxiliary reservoir.

UC equipped cars on the emergency reservoir.

D-22 equipped cars on the brake cylinder.

Freight Equipment

Triple valve equipped cars on the auxiliary reservoir, unless this location does not present a clear view from outside of car, then the stenciling should be near the handle of release rod on reservoir side of car.

On tank cars having but two longitudinal sills, the stenciling may be at center of car on center sill, reservoir side.

AB equipped cars should be stenciled on the auxiliary and emergency reservoirs.

Cleaning, lubricating and testing may be done on all

cars when available within one month less than the maximum time stated above.

When lubricating AB brake cylinders the grease specified by the A. A. R. must be used.

46. Applying Valve Gaskets—The gaskets on P, L, and K triple valves must be applied to the valves; the gaskets on AB, U-12, and D-22 valves must be applied to the pipe bracket. The rib side of the gasket should always be next to the valve; they must be inspected and known to be in good condition.

47. Applying Valves—Precautions—In applying the triple valve and parts of the AB, U-12, and D-22 valves, it should be known that the induction or supply pipe to the brake cylinder is clean and that all ports in the pipe brackets are open and free from any foreign substance. The branch pipe should be thoroughly blown out and the cone shaped strainer, in the branch pipe leading to the triple or U-12 bracket, thoroughly cleaned before the valves are connected. The hair strainers in the pipe bracket of the AB and D-22 valves must be renewed. It should be known that the air escapes freely past the brake pipe strainer or centrifugal dirt collector, and if it does not, they should be cleaned or renewed; in case of renewal, the old parts must be sent to the shop for repairs. In all cases, when blowing out the centrifugal dirt collector, it must be disconnected from the valve.

48. Testing Brakes After Applying Valves—When a new or repaired valve is applied, a test must be made to ascertain that the brakes will apply in both service and emergency applications, and release when operated in the proper manner. All necessary light repairs to the brake pipe, pipe hangers, angle cocks or brake pipe end

cocks, and hose couplings must be made and the piston travel adjusted to the minimum.

49. Examination and Repairs to Brake Apparatus—Examine carefully all parts of the brake rigging, making repairs such as tightening of unions, applying cot-
ters in brake lever pins, brake beams and connections, application of brake shoes, defective hose and couplings, including gaskets, burst or broken pipes, loose or missing pipe hangers, retaining valves and their pipes, also adjusting angle cocks so as to set at an angle of 30 degrees, as shown on standard tracing (See Fig. 8). Nuts and bolts securing brake cylinder and auxiliary reservoir to car body must be tightened.

50. Adjustment of Brake Rigging—Brakes must be adjusted, being guided by clearance of brake shoes on the wheels, and not neglecting the adjustment of bottom connections, so as to put levers in proper relation to one another.

51. Automatic Slack Adjusters—There are five types of automatic slack adjusters in general use, A, B, C, J and K. The B, J and K types are used where the adjuster is mounted on the pressure head of the brake cylinder; type A where the adjuster and brake cylinder are on the end of the truck frame; type C where the adjuster and cylinder are on the side or top of the truck frame. Types A, B, and C are known as the "divided engine" type with the engine portion centrally located with the spring and its piston on opposite sides of the ratchet nut.

To apply new brake shoes, first turn the slack adjuster nut one quarter turn to the right to disengage the pawl, then turn the slack adjuster nut to the left until the slack is sufficient. If the adjuster crosshead is

at the outer end of the adjuster body and locked, loosen the stop screw about one eighth of an inch, turn the adjuster nut one quarter turn to the right and then to the left to let out the required slack. On the "J" type the stop screw must be tightened after proper adjustments have been made. The adjusting screw should be kept free of all lubricant so as to avoid the collection of dirt. The adjustment of the foundation brake rigging should not be changed except to restore original conditions.

52. Inspection and Repairs of Hand Brake Connections—All parts and connections of the hand brake should be carefully examined and any necessary changes and repairs made.

53. Water Raising System on Passenger Cars—The general arrangement of this system is shown in Fig. 9. To fill the water tank W move handle H to a vertical position and close drain valve D by moving its handle to a horizontal position. Then fill the tank W by admitting water through inlet A, until water flows from inlet A, when the tank will be full. When handle H is in a vertical position the air is automatically cut off from the system by the five way cock V. As soon as the tank W is filled, handle H must be moved to a horizontal position and secured there, and drain valve D must be opened by moving its handle to a vertical position.

To ascertain if the tank W is sufficiently full, proceed as follows: Move handle H to a vertical position, if the ensuing exhaust of air is short, the tank is nearly full, but if long, the tank should be filled as above.

To drain the system, remove the cap from the water tank and after the tank is empty replace the cap. All drain cocks inside of car should be opened and the hop-

pers flushed. Handle H should be placed in a vertical position and drain valve D opened. The air pressure may be cut off the system by closing cut-out cock C. Air pressure must not be shut off until all the water is drained.

The system may be cut off from the car by closing stop cock S, but this should only be done when absolutely necessary.

On streamlined and later type cars the water raising system consists of an air storage reservoir, a combined governor and reducing valve, a water tank and two water filling valves Fig. 10. One filling valve is located on each side of the car in order to fill the water tank from either side.

The air storage reservoir is used to store air supplied through the combined governor and reducing valve, for use in raising and circulating water.

The combined governor and reducing valve regulates the charging of the air storage reservoir and the flow of air to the water raising system. It consists of a pipe bracket on which are mounted the governor and reducing valve portions and two cut-out cocks operated by one handle. The cut-out cocks provide for cutting out the system and also for removal of the governor and reducing valve portions without draining air from either the air storage or supply reservoirs.

The water filling valve, Fig. 10, has six pipe connections: one at the valve cut-out cock for the air pipe from the combined governor and reducing valve, one on the opposite side of the cut-out cock is for the air pipe to the water tank and the third cut-out cock connection is for the exhaust. A 2" pipe connection at the bottom is the water pipe to the water tank and two $\frac{3}{8}$ " pipe con-

nections to the body of the valve are for the heater pipes.

Operation of the water filling valve is controlled by the three way cut-out cock handle. To fill the water tank turn the handle down which will shut off the air pressure and allow the top valve to be lifted and a water hose with a protected nozzle inserted far enough to unseat the inner valve and thus fill the tank. After filling the tank the hose is removed, the inner valve is seated by a spring and the outer valve is held closed by raising the handle to a vertical position. The system is now ready for supplying water to the car.

The system can be cut out from the car by closing the two cut-out cocks in the governor and reducing valve portion by placing the handle in a horizontal position.

To drain the system, all the drain cocks inside the car should be opened and left open, the water tank drained, all hoppers flushed.

Be sure that the system is *drained* whenever conditions are such that the water is *liable to freeze*. Thus, if, at the lay-over point—unless the lay-over is unusually short—there is no equipment to keep the car heated, the system should be drained as above. Air pressure must not be shut off until all the water is drained.

SPECIAL INSTRUCTIONS FOR CONTROLLING FREIGHT TRAINS WITH POWER BRAKES ON HEAVY DESCENDING GRADES

54. Locomotive Equipment—No locomotive shall be used to handle a train of more than 1600 gross tons and the length of train must not exceed 40 cars, unless it is equipped with a cross-compound pump, M3 feed valve, and double top governor set to maintain the reservoir pressure at 100 and 130 pounds.

The air brake equipment on the locomotive must be inspected, tested and repaired in accordance with Paragraphs 21 and 22. The Enginehouse Foreman must at all times know these instructions are properly followed.

The engineman must also inspect and test the air brake equipment on his locomotive prior to departure from the engine terminal.

55. Car Equipment—The air brake equipment on all cars of trains dispatched over the following grades: (Also shown in division time tables.)

Newton and Pottsville, Pa.

Frackville and Morris, Pa.

Rhoads to Snow Shoe Intersection, Pa.

Summit to Vail, Pa.

Keating Summit Grade, Pa.

Kane to Wilcox, Pa.

Gallitzin to Slope, Pa.

Gallitzin to Wye, Pa.

Madison Hill, Ind.

South Fork Branch, Summit to Lovett, Pa.

Beaver Branch, Pa.

Llanfair Branch, Pa.

must be inspected, tested and repaired in accordance with the following instructions. On other grades, where

the time-table instructions specify the use of retaining valves, no special retaining valve test is required.

55-a. Piston Travel Adjustment—Piston travel less than 7 inches or more than 9 inches, must be adjusted to nominally 8 inches.

55-b. Brake Pipe Leakage—Charge the brake pipe to not less than 70 pounds, after which make a 15-pound brake pipe reduction and note the leakage, which must not exceed 5 pounds per minute.

55-c. Brake Cylinder and Retaining Valve Test—The foreman of car inspectors, or his representative will be held responsible for the condition of the air brake equipment in trains dispatched from their respective terminals.

The brake cylinder and retaining valve leakage must not exceed an amount which will permit the brake cylinder pressure to leak off in 3 minutes, with retaining valve handle in horizontal position and triple valve in release position. In making retaining valve tests, car inspector will record each retaining valve which blows as the handle is turned down as an effective grade brake. The two-position retaining valve may be computed as an effective grade brake for 50 tons, and the three-position retaining valve for 95 tons. Example, multiply the total number of two-position retaining valves that hold 3 minutes by 50 tons, and the total number of three-position retaining valves by 95 tons, and the result of the two, will equal the retaining valve value of the train which must be equal to, or greater than the gross tonnage of the train. When specified these values can be raised to 75 tons and 105 tons respectively.

To determine the tons per effective brake divide the

gross tonnage of the train by the total number of effective grade brakes.

To determine the tons per operative brake, divide the gross tonnage of the train by the total number of cars with operative brake.

If the average tonnage exceeds the maximum tons per effective grade brake with the air brake equipment on all cars meeting the above requirements, the make up of the train must be changed and a sufficient number of cars of lower capacity added to reduce the maximum tons per effective grade brake to that specified, or less.

55-d. Air Brake Clearance Card—After tests and repairs have been completed, the Foreman of Car Inspectors, or his representative, will fill out Air Brake Clearance Card M. P. 261 in duplicate, as outlined in paragraph 56-b, showing the condition of air brake equipment on cars in train and forward the original copy to person designated, retaining the carbon copy for his file.

56. Operation—The engineman and conductor moving trains over the grades specified by Instruction 55 must know that the air brake on locomotives and cars is in serviceable condition to safely handle the train. Unless the inspection, testing and repairing of the cars as prescribed in Instructions 55-a to 55-d inclusive, have been made by other employes and Air Brake Clearance Card furnished, the engineman and conductor must make the inspection and tests prescribed by Instructions 56-a and 56-b.

56-a. After the brake pipe is charged to the standard pressure, the engineman will make a 15-pound brake pipe reduction and note the brake pipe leakage, which must not exceed 5 pounds per minute. The train crew

will place the handle of the pressure retaining valve on the cars in a horizontal position, which is for the minimum pressure retained by the valve, after which the engineman will increase the reduction to 25 pounds and release the brakes. The trainmen will then make an inspection of the train brakes, and all brakes that leak off before 3 minutes have elapsed shall be considered ineffective grade air brakes when computing the number of tons per car with effective brakes. In making retaining valve tests, trainmen will record each retaining valve which blows as the handle is turned down as an effective grade brake.

To compute the retaining valve value of the train see Instruction 55-c.

Trains of low tonnage, such as preference trains, or trains composed of empties and loads, the three-position retaining valve may be operated in the low pressure position and its value as an effective grade brake reduced from 95 to 50 tons when computing the retaining valve value for the train.

56-b. The Conductor moving the train will fill out his own Air Brake Clearance Card, after the air brake test has been made at the designated point, showing the condition of the train brakes, which must be signed by him and turned over to the Engineman, with any written comments he may have to make as to the condition of the train brakes, together with the number of tons per effective grade brake. When the air brake tests are made by Car Inspectors, the crew will only be required to make a road test of the train brakes. The inspectors will furnish the Conductor with an Air Brake Clearance Card which must be signed by him and delivered to the Engineman, who will sign and deliver it with his Time Card.

THE PENNSYLVANIA RAILROAD **AIR BRAKE CLEARANCE CARD FOR FREIGHT TRAIN OPERATION ON HEAVY** **DESCENDING GRADES**

Train Symbol.....	Place.....	Date.....	Locomotive No.....
No. of Cars in Train—Loaded.....	Empty		Total
Was Piston Travel Adjusted as per Instruction	99-C-1.....		
		(x 50 Tons.....	
No. of 2-Position Retaining Valves.....	No. Effective.....	(x 75 Tons.....	
		(x 95 Tons.....	
No. of 3-position Retaining Valves.....	No. Effective.....	(x 105 Tons.....	
		Total Retaining Valve	
		Value in Tons	
	Total.....	Total.....	

Remarks:

Gross Tonnage of Train.....Tons per effective Grade Brake.....

Brake Pipe Leakage.....Lbs. per minute. Tons per operative brake.....

Conductor

Engineman

Note: Gross Tonnage of Train must not exceed retaining valve value. The maximum of 75 and 105 tons only applies between Gallitzin, Slope and Wye; Kane and Wilcox; Keating Summit and Sizerville.

.....Foreman of Car Inspectors

56-c. After the grade brake test has been made, if a train is delayed at any point a sufficient length of time to endanger the safety of the train air brakes, a road test must be made before proceeding. If anything should occur to prevent the proper operation of the train brakes, such as not being able to safely control the speed of the train or apply and release the brakes from the locomotive, a terminal test of the train brakes must be made.

56-d. The brake pipe pressure must be 95 to 100 pounds on freight trains of loaded cars, before descending specified heavy grades. The pressure to be obtained as follows: Locomotives equipped with Type C-6 feed valve and Duplex compressor governor, the automatic brake valve must be carried in full release position. Locomotives equipped with Type M-3 feed valve and Duplex compressor governor with cut-out cock in low pressure governor pipe to brake valve, the automatic brake valve must be carried in running position, the cut-out cock in low pressure governor pipe closed and the feed valve adjusted to obtain the required pressure in the brake pipe. On other grades, the brake pipe pressure must conform to time-table instructions. The Engineman must operate the air brake in such a manner as to maintain a brake pipe pressure of not less than 70 pounds at all times.

On trains of empty cars on such grades, the brake pipe pressure must be the standard, 70 pounds. The pressure retaining valves must be operated in low pressure position on 30 to 50 percent of the cars in empty trains as required.

56-e. The schedule running time between points on grades must be established and the speeds prescribed

for various grades must not be exceeded. See table—
Pages 73 to 76 inc.

57. In order to avoid exceeding allowable speed, the Engineman must make a brake application as soon as practicable after locomotive passes over the Summit, followed by additional application of a sufficient number to keep the speed uniform. When making brake applications, the brake valve handle should be moved from release or running position to service position promptly, and, after the desired reduction is obtained, back to and held on lap position as conditions may require, then moved to release position, when locomotive is equipped with C-6 feed valve, to running position when locomotive is equipped with M-3 feed valve. To keep speed reduced as required involves frequent applications to maintain the desired pressures and allow maximum time for recharging the auxiliary reservoirs on the cars.

58. Should it become evident to the Engineman operating on the grade that the brake is not controlling the train effectively, or in attempting to do so, he is running the risk of depleting the air supply below 70 pounds brake pipe pressure, he must immediately stop the train; if the brake pipe pressure cannot be restored to the maximum, he will arrange with the Conductor for correcting the defect or for the necessary assistance in order that he may proceed to his destination. When a train is stopped for any cause on the grade, Trainmen must immediately apply a sufficient number of hand brakes to hold the train, the air brakes should then be released and not used to hold the train on the grade.

59. Retaining valves must not be released when approaching the foot of the grade until a proper whistle

signal is received from the Engineman to release them.

60. All Conductors and Enginemen must be duly qualified and instructed as to their duties and knowledge in connection with making air brake and retaining valve tests and operation of trains controlled by power brakes on heavy descending grades. Copy below showing form to be prepared for permanent file:

**THE PENNSYLVANIA RAILROAD
CONDUCTORS OR ENGINEMEN — AIR BRAKE
QUALIFICATION CARD**

.....Division Date.....

.....Descending Grade

This to certify

Name

.....has been duly

Occupation

instructed and qualified to operate and control trains
on descending grades by use of power brakes.

.....

Road Foreman of Engines

.....

Train Master

STEAM LOCOMOTIVES—MAIN RESERVOIRS

Locomotive Class	Number Required	Dimension—Inches	Volume Each Reservoir Cubic Inches	Total Volume
A5s.....	1 1	21¼ x 41 26½ x 41¼	13800 19550	33350
B6.....	2	21¼ x 41	13800	27600
B6s, B6sa, B6sb, E8 B8a, D16sb.....	2	25 ½ x 41¼	19550	39100
B28s.....	2	18½ x 66	16900	33800
C1, K4s, K5.....	1 1	23¼ x 42 23¼ x 84	16500 34400	51000
E3sd, E5s.....	2	16½ x 90	18300	36600
E6s.....	1 1	16½ x 90 16½ x 138	18300 28300	46900
G5s.....	1 2	23¼ x 54 16½ x 72	21700 14600	50900
H6sb.....	1 1	23¼ x 66 23¼ x 90	26800 37000	63800
H8a, H8b, H8sa, H8sb, H8sc, H9s, H9sa, H9sc, H10s.....	2	23¼ x 90	37000	74000
HH1.....	1 1 1	16 x 60 16 x 150 22½ x 120	10800 28005 44056	82861
I1s, I1sa.....	1 2	23½ x 54 32 x 39	21700 27000	75700
J1, J1a.....	1 1 2	14 x 96 14 x 108 14 x 144	14778 15625 22167	75737
K2s, K2sa, K3s.....	2	16 x 138	27050	54100
L1s.....	3	23¼ x 66	28800	80400
L2s.....	3	20 x 72	21610	64830
M1, M1a.....	2	23¼ x 66	26800	53600
N1s.....	1	36 x 84	82450	82450
N2sa.....	1 2	20 x 102 20 x 72	31035 21610	74255
Q1.....	1 1	21¼ x 108 20 x 102	37135 31035	68170
Q2.....	1 1 1 1	14 x 48 14 x 108 14 x 166 18¾ x 96	6585 16625 25245 24175	72630

STEAM LOCOMOTIVES—MAIN RESERVOIRS

Locomotive Class	Number Required	Dimension—Inches	Volume Each Reservoir Cubic Inches	Total Volume
SI, T1.....	1	18½ x 54	13375	68700
	2	18½ x 60	14750	
	1	22½ x 72	25825	
S-2.....	2	22½ x 84	30325	60650

ELECTRIC LOCOMOTIVES—MAIN RESERVOIRS

Locomotive Class	Number Required	Dimension—Inches	Volume Each Reservoir Cubic Inches	Total Volume
A6, A6b.....	2	16½ x 90	18300	36600
AA5, AA5b, AA10e.....	2	22½ x 84	30325	60650
AA5a, AA10b.....	2	24½ x 72	33942	67884
B1, B3.....	2	16½ x 90	18300	36600
DD1.....	4	18½ x 90	23300	93200
DD2, L6, L6a.....	4	14 x 126	18980	75920
GG1.....	4	15½ x 78	14400	57600
L5PAW.....	4	16½ x 90	18300	73200
O1, O1a, O1b, O1c, P5, P5a, P5b.....	2	17 x 146	33139	66278
R1.....	2	20 x 106	33305	66610

STANDARD WEIGHT PASSENGER EQUIPMENT CARS

Class of Car	Brake Schedule	Type of Valve	Number and Size Reservoirs	Volume Cubic Ins.
B60, B60a, B60b, MP54, MPB54, MPBM54, MBM62, MPB54b, R50b..	UC-1412	U12BC	1 Aux. 10 x 33 1 Ser. 12 x 33 1 Emer. 22½ x 36	2125 3088 14314
P70, PB70, PBM70, PBM70A, B70, M70, M70a, B74a, All BM70 cars.....	UC-1412	U12BC	1 Aux. 10 x 33 1 Ser. 14 x 33 1 Emer. 20½ x 54	2125 4318 17823
D70, D78, D78a, D78b.....	UC-1812	U12BC	1 Aux. 10 x 33 1 Ser. 16 x 33 1 Emer. 22½ x 54	2125 5588 18967

LIGHT WEIGHT PASSENGER EQUIPMENT CARS

P85r, PDB85r, POC85r, D85r.....	HSC	D22BR	1 Aux. 1607 1 Emer. 3298 2 Supply 16 x 72	13900 ea.
D82r.....	D22A	D22A	1 Aux. 1607 1 Emer. 3298 1 Supply 16 x 66 1 16 x 72	13266 13900
D82r, P82r.....	D22A	D22A	1 Aux. 1607 1 Emer. 3298 2 Supply 16 x 72	13900 ea.
P82ar.....	D22B	D22B	1 Aux. 1607 1 Emer. 3298 2 Supply 16 x 72	13900 ea.

STEAM SUBURBAN CARS

MP54, MPB54, MBM62.....	PM-1412	P-Triple	1 Aux. 14 x 33	4318
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MU CARS

MP54E, MP54E1, MP54E2, MPB54E, MBM62E, MB62E.....	AMUE-1612	UE12BC	1 Aux. 10 x 33 1 Ser. 14 x 33 1 Emer. 20½ x 54	2125 4318 17823
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FREIGHT CARS EQUIPPED FOR PASSENGER SERVICE

	AB-1-B	AB-1-B	1 Aux. 1 Emer.	2440 3088
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FREIGHT EQUIPMENT CARS

	KC or KD	K	1 Auxiliary	2440
	AB	AB	1 Aux. 1 Emer.	2440 3088

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P. R. R. GRADE
TRAINS HAVING AN AVERAGE TONNAGE OF
LESS THAN 51 TONS PER EFFECTIVE BRAKE

Points	Grade	Dis- tance Miles	Miles per Hour	Min- utes
Newton to Rock	1.5 to 1.75	3.4	20	10
Rock to Morris	1.2 to 2.9	2.5	15	10
Morris to St. Clair	2.9 to 3.1	2.2	12	11
St. Clair to Pottsville .....	.5 to 1.5	2.7	20	8
Total		10.8		39

TRAINS HAVING AN AVERAGE TONNAGE OF 51
TO 80 TONS PER EFFECTIVE BRAKE

Newton to Rock	1.5 to 1.75	3.4	16	13
Rock to Morris	1.2 to 2.9	2.5	10	15
Morris to St. Clair	2.9 to 3.1	2.2	8	16.5
St. Clair to Pottsville .....	.5 to 1.5	2.7	16	10
Total		10.8		54.5

READING COMPANY GRADE—FRACKVILLE TO
WETHERILL JCT. & P. R. R. GRADE—
WETHERILL JCT. TO MORRIS

Frackville to Wetherill Jct. (Reading)	3.3	1.9	8	14
Wetherill Jct. to Morris (P. R. R.) .....	.7	.5	16	1.8

P. R. R. GRADE

TRAINS HAVING AN AVERAGE TONNAGE OF 80
TO 95 TONS PER EFFECTIVE BRAKE

Newton to Rock	1.5 to 1.75	3.4	16	13
Rock to Morris	1.2 to 2.9	2.5	8	19
Morris to St. Clair	2.9 to 3.1	2.2	6	22
St. Clair to Pottsville .....	.5 to 1.5	2.7	16	10
Total		10.8		64

CLEARFIELD BRANCH
TRAINS HAVING AN AVERAGE TONNAGE OF
LESS THAN 51 TONS PER EFFECTIVE BRAKE

Points	Grade	Dis- tance Miles	Miles per Hour	Min- utes
Summit to north end of Big Fill	1.98	2.5	16	10
North end of Big Fill to a point 1.2 miles south of Gardner .....	.11 to 1.98	3.5	16	14
Point 1.2 miles south of Gardner to Vail	2.2 to 2.86	3.8	12	19
Total		9.8		43

TRAINS HAVING AN AVERAGE TONNAGE OF 51
TO 95 TONS PER EFFECTIVE BRAKE

Summit to north end of Big Fill	1.98	2.5	10.7	14
North end of Big Fill to a point 1.2 miles south of Gardner .....	.11 to 1.98	3.5	13.125	16
Point 1.2 miles south of Gardner to Vail	2.2 to 2.86	3.8	9.1	25
Total		9.8		55

SNOW SHOE BRANCH
TRAINS HAVING AN AVERAGE TONNAGE OF
LESS THAN 51 TONS PER EFFECTIVE BRAKE

Rhoads to No. 4 Switch..	2.27-2.16-2.09	2.46	15	10
No. 4 Switch to No. 3 Switch	2.0 -2.18	1.09	15	5
No. 3 Switch to No. 2 Switch	2.0	.61	15	3
No. 2 Switch to No. 1 Switch	2.0	.44	15	2
No. 1 Switch to Gum Stump	2.84-1.53	2.30	15	10
Total		6.9		30

TRAINS HAVING AN AVERAGE TONNAGE OF 51
TO 95 TONS PER EFFECTIVE BRAKE

Rhoads to No. 4 Switch..	2.27-2.16-2.09	2.46	12	13
No. 4 Switch to No. 3 Switch	2.0 -2.18	1.09	12	6
No. 3 Switch to No. 2 Switch	2.0	.61	12	3
No. 2 Switch to No. 1 Switch	2.0	.44	12	3
No. 1 Switch to Gum Stump	2.84-1.53	2.30	12	12
Total		6.9		37

PITTSBURGH DIVISION—Gallitzin to Slope
(Main Line)

**TRAINS HAVING AN AVERAGE TONNAGE OF 60
TONS OR LESS PER EFFECTIVE BRAKE**

Points	Grade	Dis- tance Miles	Miles per Hour	Min- utes
AR to SF	1.39 to 2.36	1.1	12	5
SF to MG	1.73 to 2.36	3.8	16	14
MG to GY	1.45 to 1.75	3.8	20	11
GY to Slope	1.47 to 1.85	2.4	18	8
Total		11.1		38

**TRAINS HAVING AN AVERAGE TONNAGE OF
OVER 60 TONS PER EFFECTIVE BRAKE**

AR to SF	1.39 to 2.36	1.1	12	5
SF to MG	1.73 to 2.36	3.8	14.5	16
MG to GY	1.45 to 1.75	3.8	17	13
GY to Slope	1.47 to 1.85	2.4	16	9
Total		11.1		43

PITTSBURGH DIVISION—Gallitzin to Wye
(New Portage Branch)

AR to SF	1.39 to 2.36	1.1	12	5
SF to MS	1.20 to 1.88	8.1	16	30
MS to Wye	1.03 to 1.81	7.2	16	27
Total		16.4		62

The maximum tonnage may be increased from 50 to 75 tons and 95 to 105 tons per effective brake, between Gallitzin and Slope or Wye.

BUFFALO DIVISION—Keating Summit Grade
**TRAINS HAVING AN AVERAGE TONNAGE OF LESS
THAN 51 TONS PER EFFECTIVE BRAKE**

Mile Post 108 to Mile Post 109....	2.1	1	15	4
Mile Post 109 to Mile Post 110....	2.2	1	15	4
Mile Post 110 to Mile Post 111....	2.1	1	15	4
Mile Post 111 to Mile Post 112....	2.2	1	15	4
Mile Post 112 to Mile Post 113....	2.1	1	15	4
Total		5		20

**BUFFALO DIVISION—Keating Summit Grade
TRAINS HAVING AN AVERAGE TONNAGE OF 51
TO 75 TONS PER EFFECTIVE BRAKE**

Points	Grade	Dis- tance Miles	Miles per Hour	Min- utes
Mile Post 108 to Mile Post 109....	2.1	1	12	5
Mile Post 109 to Mile Post 110....	2.2	1	12	5
Mile Post 110 to Mile Post 111....	2.1	1	12	5
Mile Post 111 to Mile Post 112....	2.2	1	12	5
Mile Post 112 to Mile Post 113....	2.1	1	12	5
Total		5		25

**TRAINS HAVING AN AVERAGE TONNAGE OVER
75 TONS PER EFFECTIVE BRAKE**

Mile Post 108 to Mile Post 109....	2.1	1	10	6
Mile Post 109 to Mile Post 110....	2.2	1	10	6
Mile Post 110 to Mile Post 111....	2.1	1	10	6
Mile Post 111 to Mile Post 112....	2.2	1	10	6
Mile Post 112 to Mile Post 113....	2.1	1	10	6
Total		5		30

The maximum tonnage may be increased from 50 to 75 tons and 95 to 105 tons per effective brake, between Keating Summit and Sizerville.

**RENOVO DIVISION—Kane to Wilcox
TRAINS HAVING AN AVERAGE TONNAGE OF LESS
THAN 51 TONS PER EFFECTIVE BRAKE**

Kane to Sergeant	2.0	4.2	15	17
Sergeant to Wilcox	1.0	4.4	24	11
Total		8.6		28

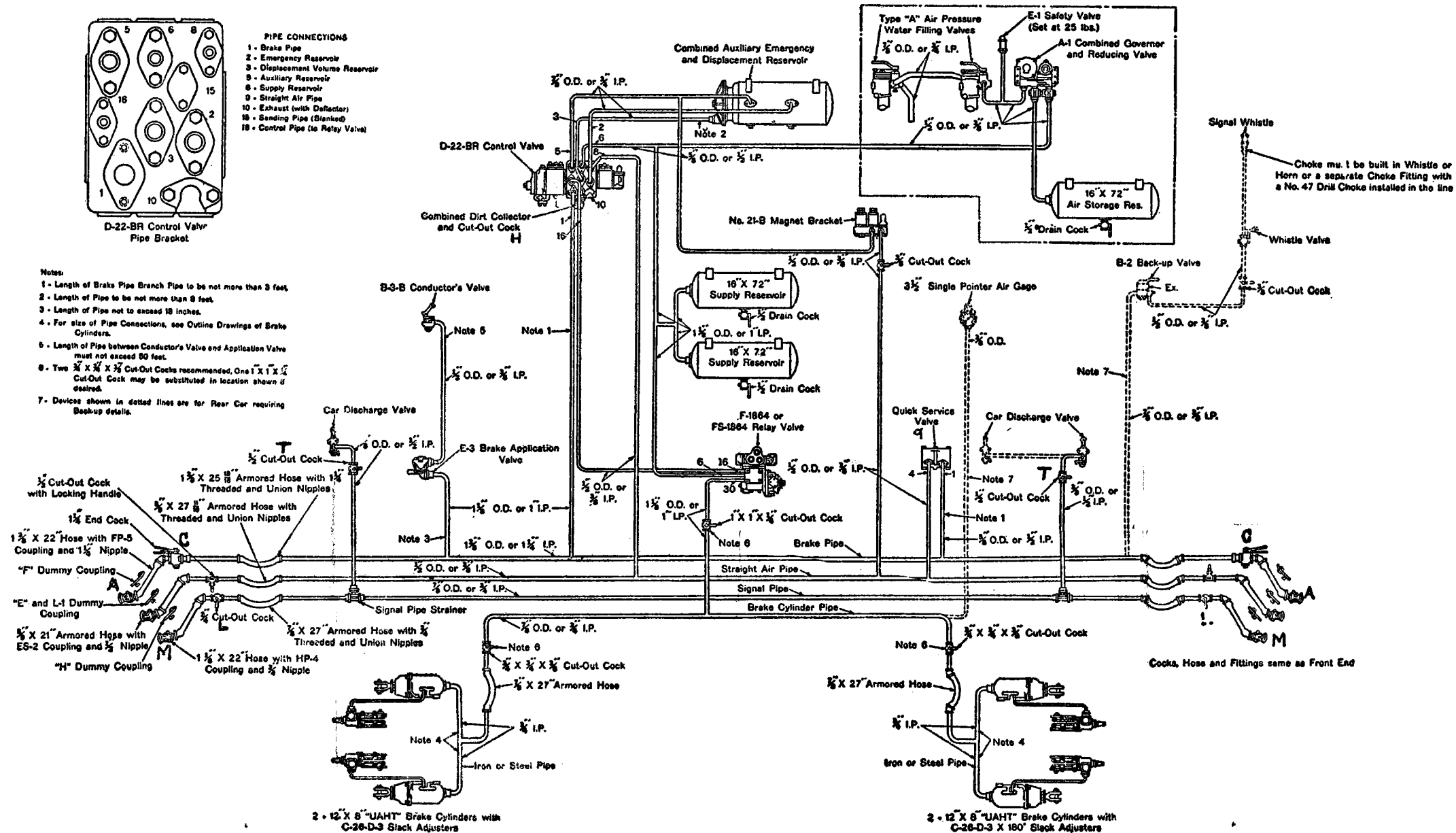
**TRAINS HAVING AN AVERAGE TONNAGE OVER 51
TONS PER EFFECTIVE BRAKE**

Kane to Sergeant	2.0	4.2	12	21
Sergeant to Wilcox	1.0	4.4	18	15
Total		8.6		36

Maximum tonnage may be increased from 50 to 75 tons, and 95 to 105 tons per effective brake between Kane and Wilcox.

**INDIANAPOLIS DIVISION—North Madison to Madison
TRAINS HAVING AN AVERAGE TONNAGE OF 51
TONS OR LESS PER EFFECTIVE BRAKE**

Derail located 1155 ft. east of North Madison Station to Bridge Main Street, Madison	5.83	1.36	12	7
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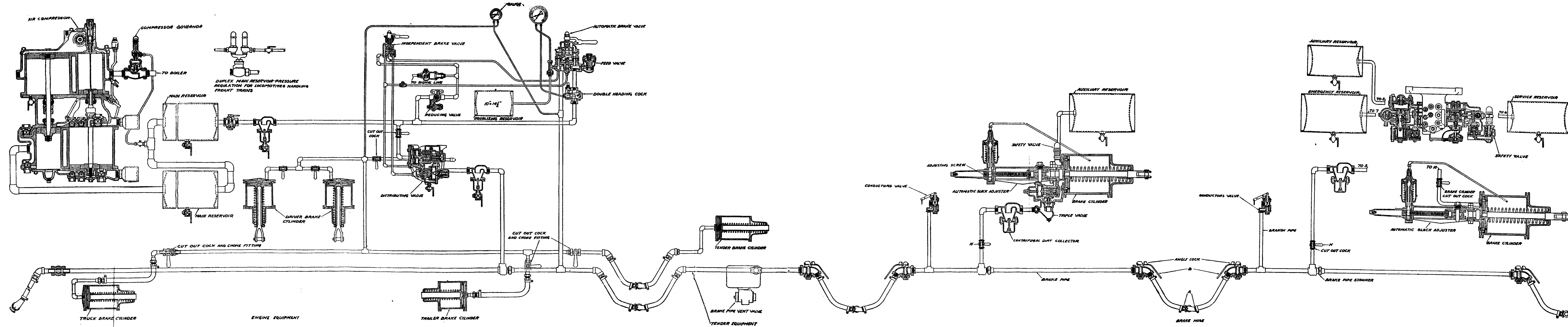


Fig. 3. Complete Air-Brake Equipment for a passenger train.

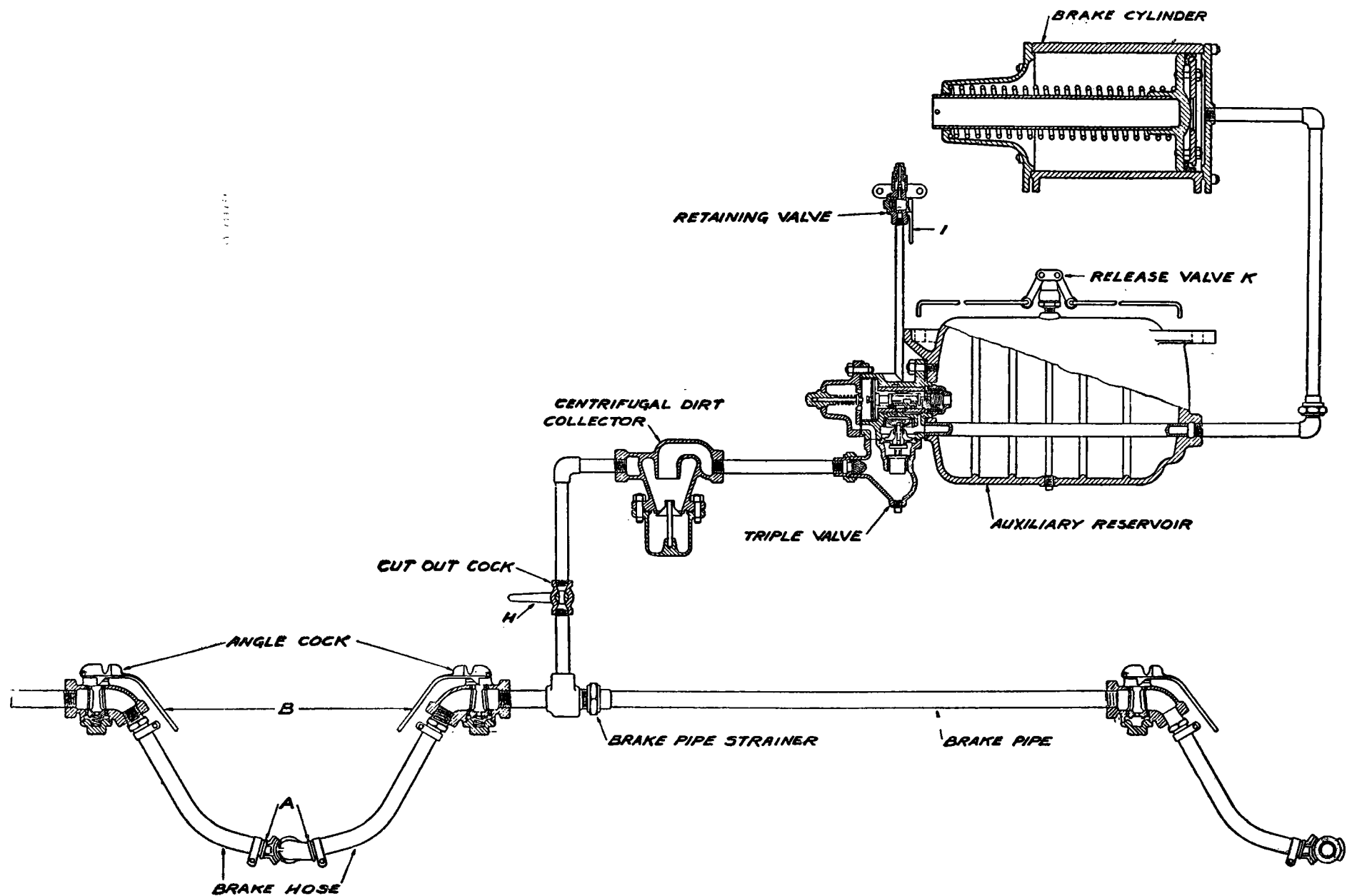


Fig. 4. Complete Air Brake Equipment for a freight car.

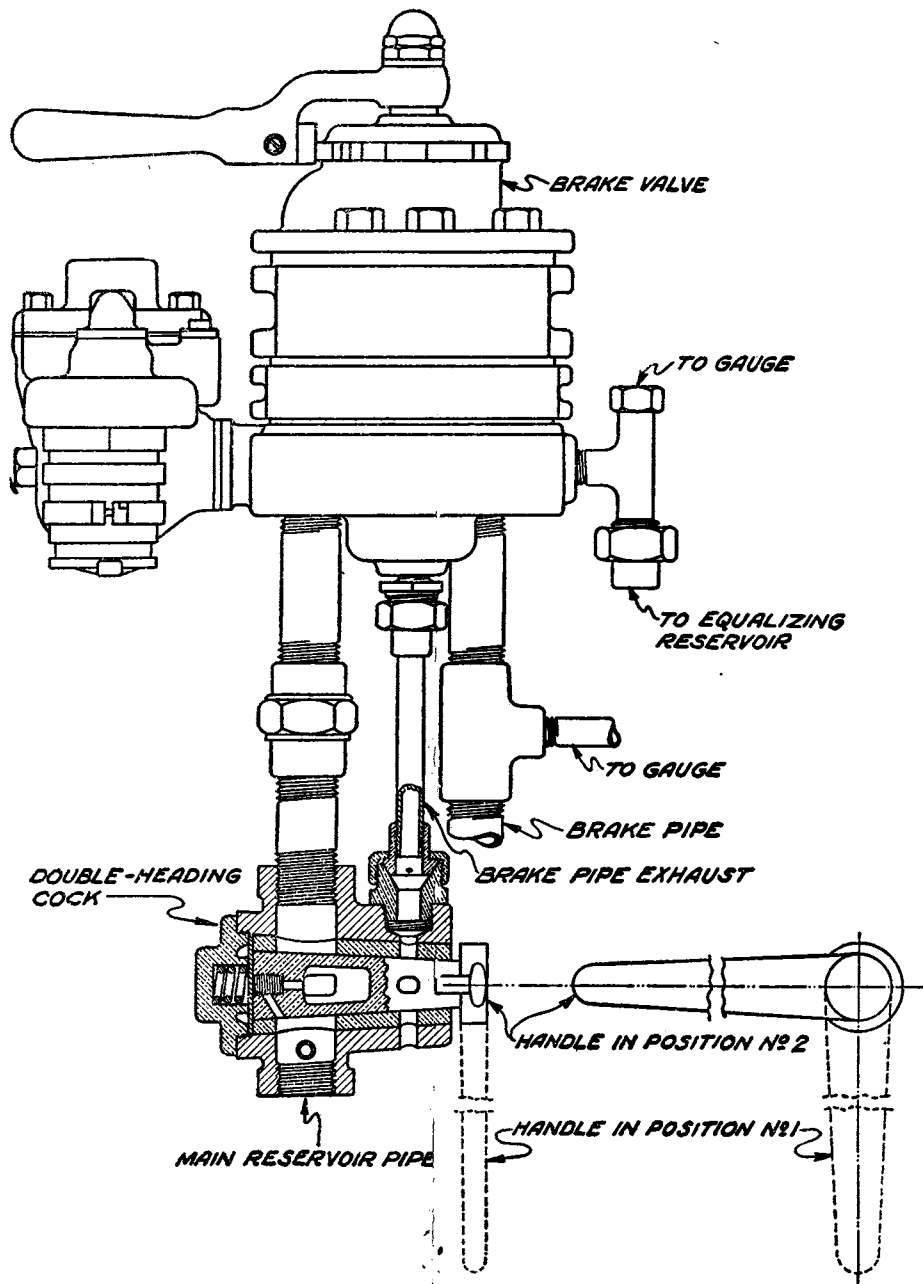
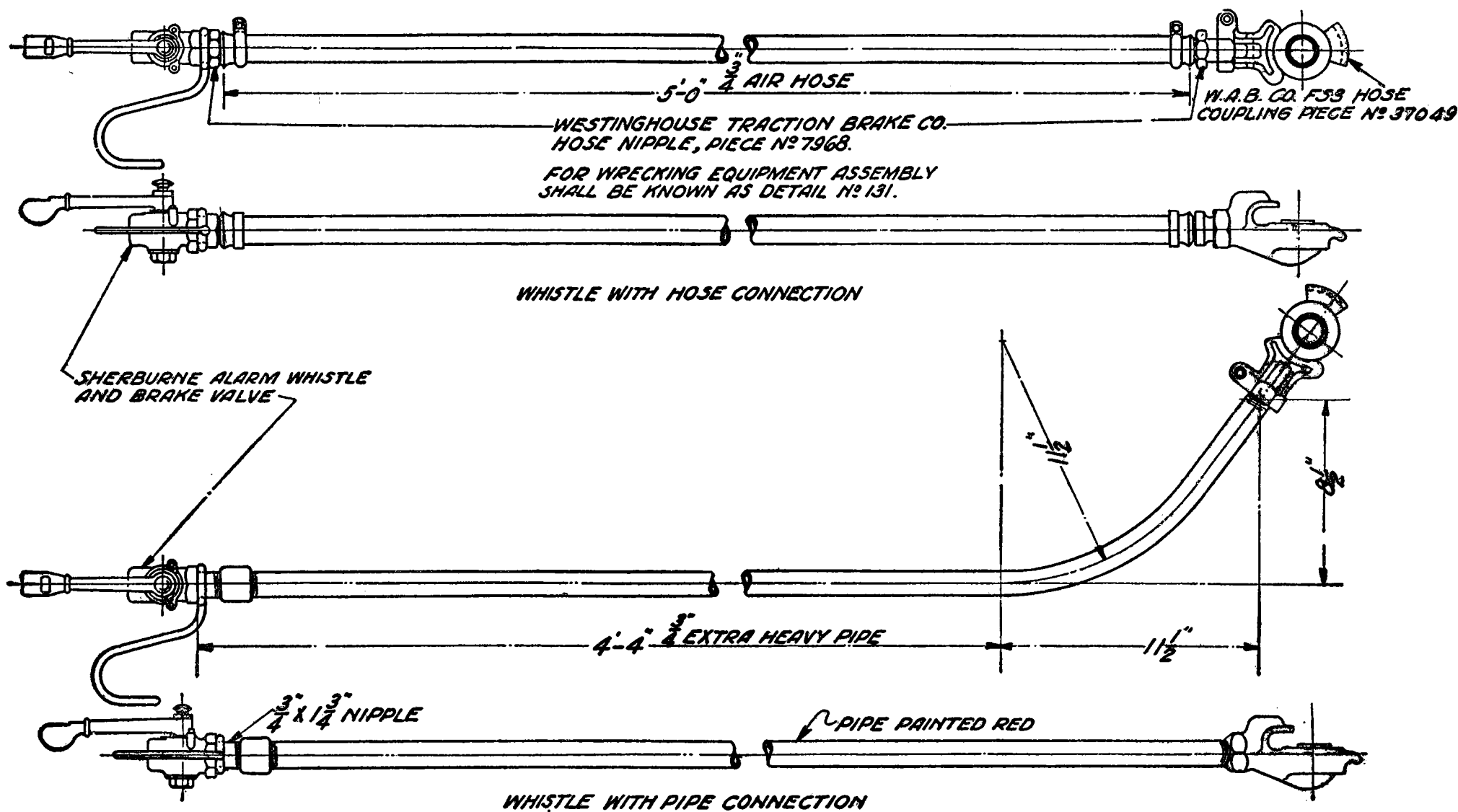


Fig. 5. Double-Heading Cock.



WHISTLE WITH HOSE CONNECTION TO BE USED ONLY
IN TERMINAL SERVICE, OR WHERE NECESSARY FOR
TRAINMEN TO FREQUENTLY MOVE SAME.

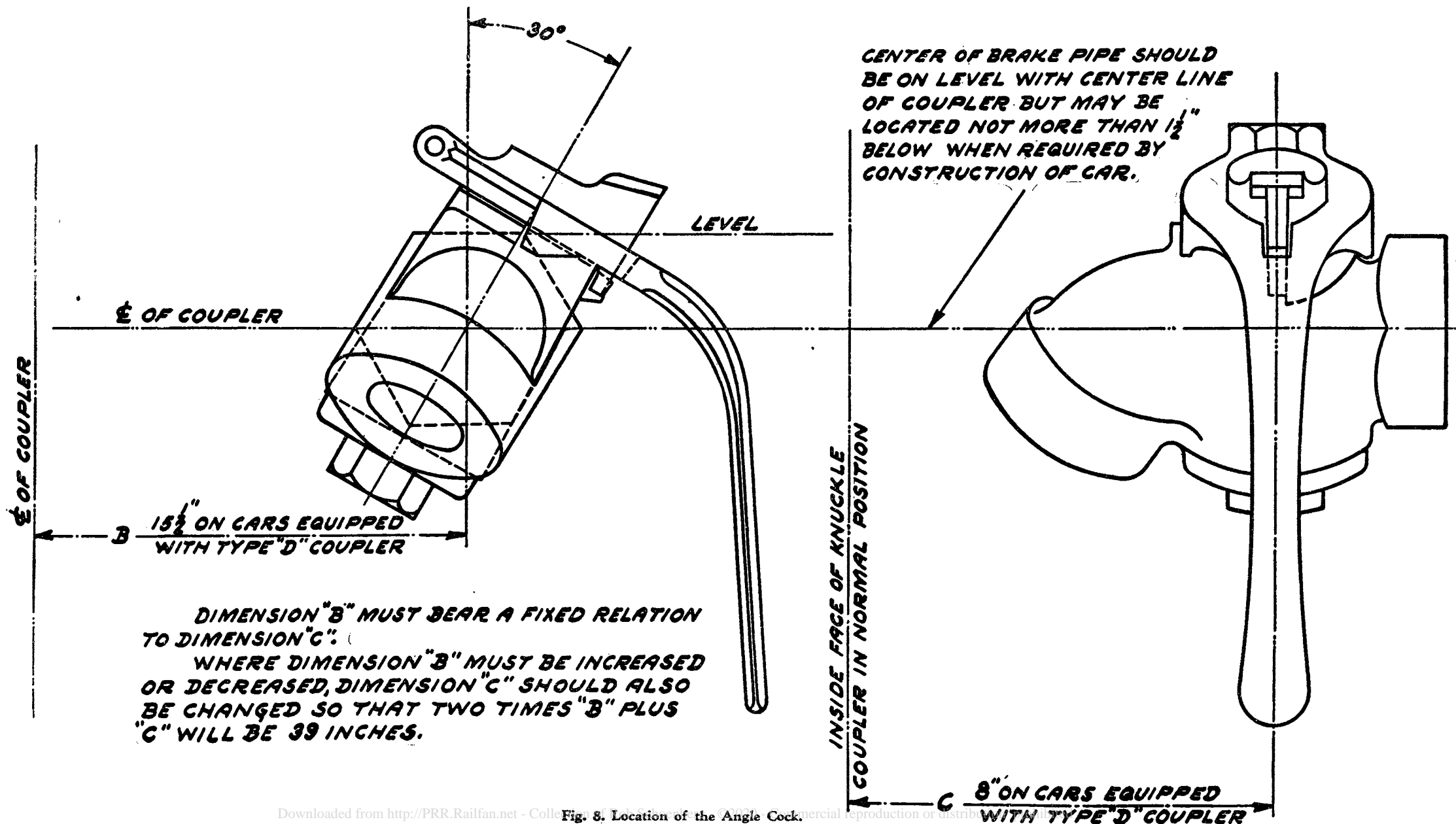


Fig. 8. Location of the Angle Cock.

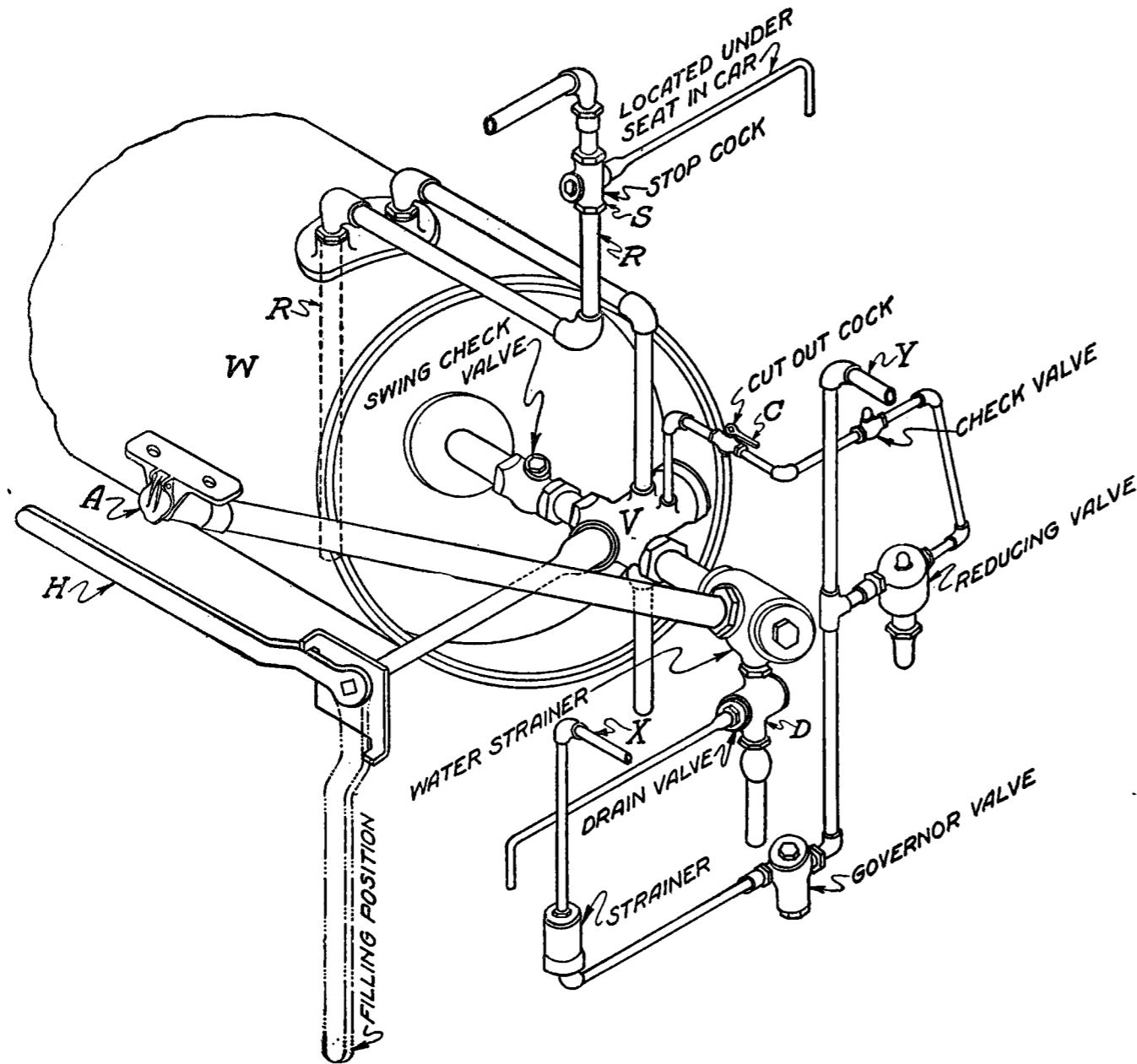
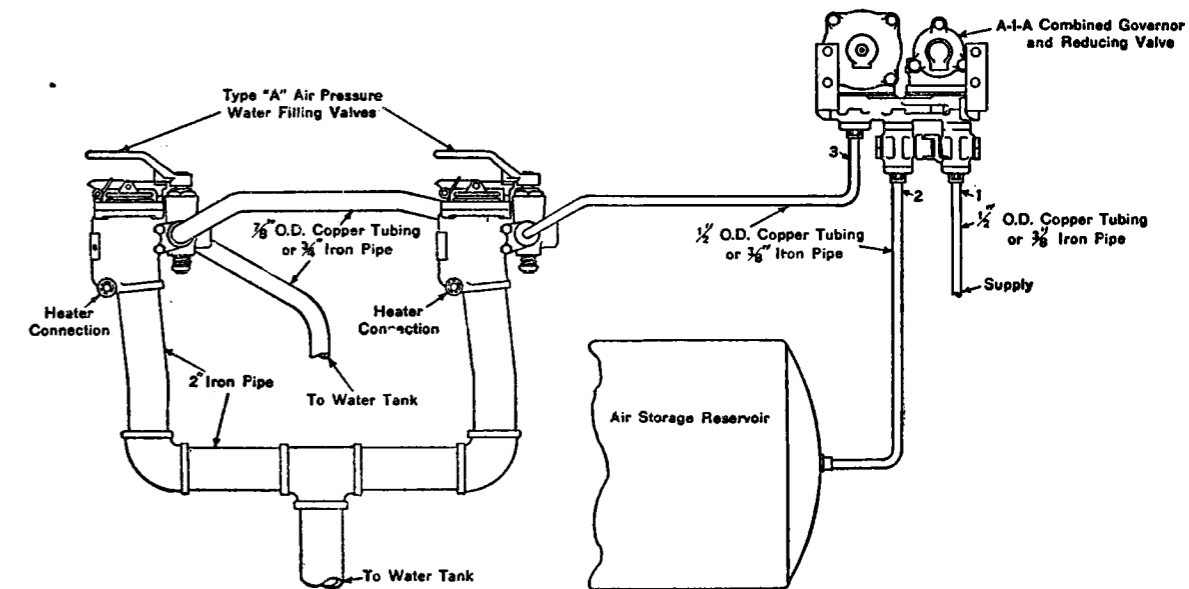


Fig. 9. The Pneumatic Water Raising System.



Typical Piping Diagram—Water Raising System

Fig. 10.

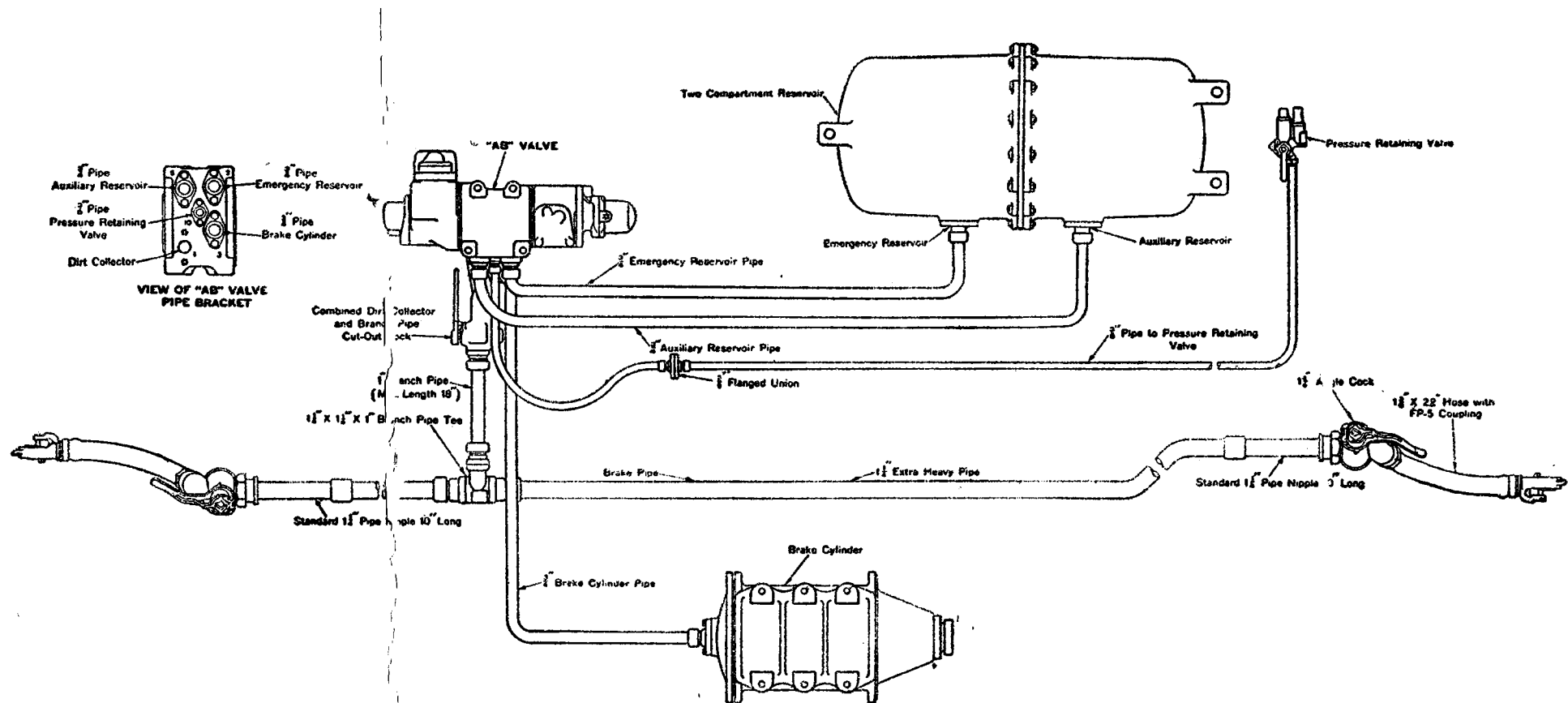


Fig. 11. Piping Diagram of the Complete "AB" Freight Car Brake Equipment.

