Fundamentals Of North American Air Brakes

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Clinic Goal

- Bring to the modeler an awareness of the principal components of modern railroad braking systems
- This is NOT an intensive Mechanical Engineering discussion
- Purpose is to help the modeler make sure that the under frame systems represent prototypical operations
- Clinician relied heavily on material developed by Al Krug
- Drawings are from an article in Railway Age, Vol. 94, No 4 (1933)
- Thanks to Tom Bookout and Ed Butcher, division resident engineers for proofing my presentation

AB Brake Equipment

- Automatic Braking – AB
- Westinghouse Air Brake Company
- In use today on many freight cars
- Latest design, ABDW, is being applied to brand new cars.
- Each use a different types of control valve but all behave in the same manner.

Major Components

- Engine has a brake valve – 26 Type
  – Extremely complex machine
- Each car has a brake valve – AB Type
  – Also extremely complex piece of machinery

Typical Location of brake equipment in Diesel Engines

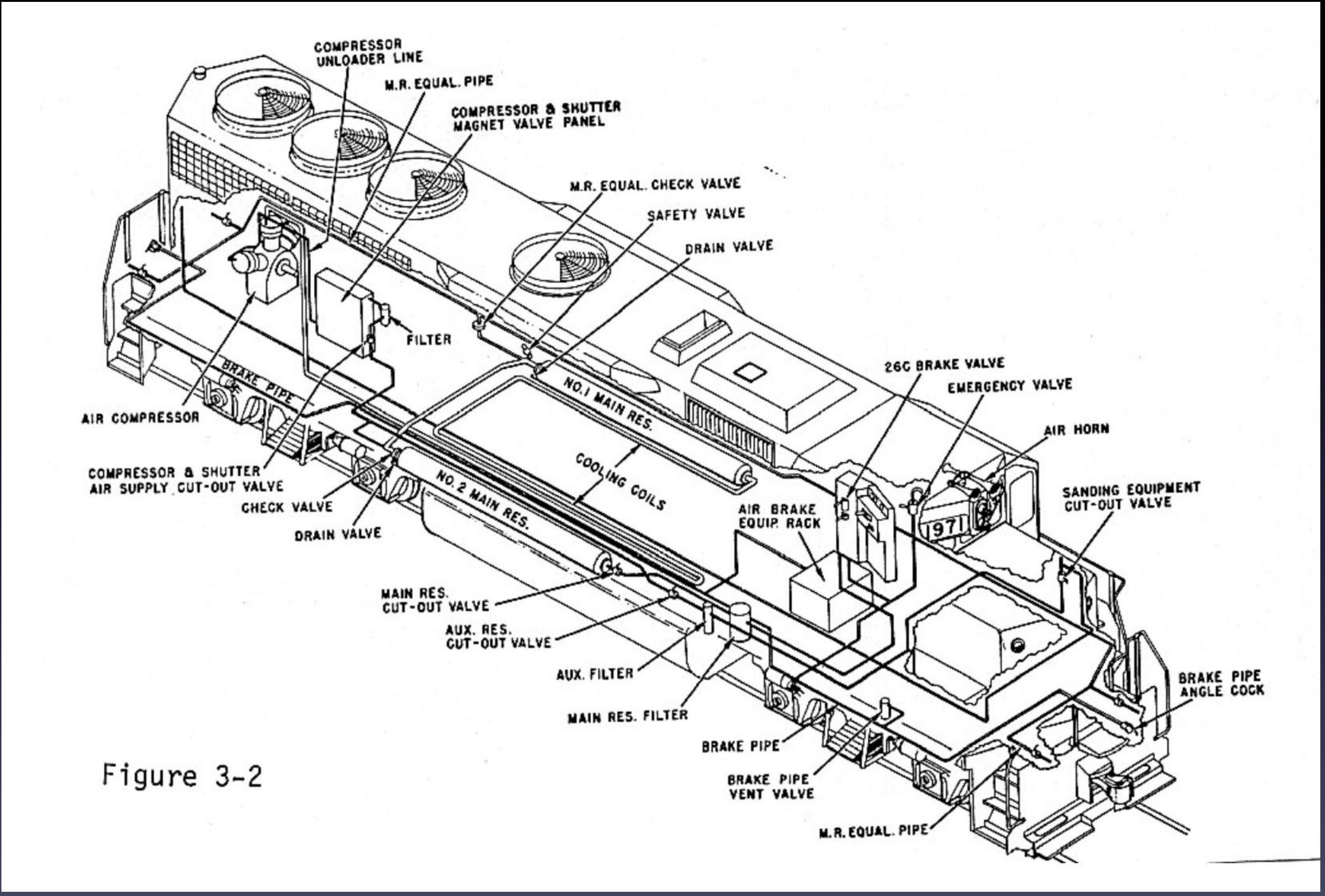


Figure 3-2

Engine Brake Valve

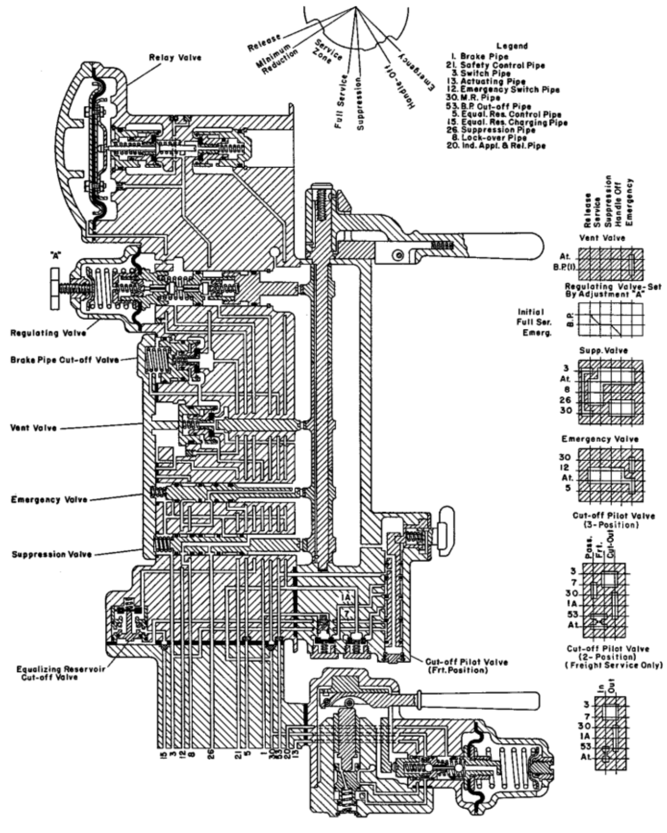


Figure 1
26-C Brake Valve

Engineer's Brake Valve

Engineer’s Brake Valve

- The brake valve has the following positions:
  - Release
  - Running
  - Lap
  - Application
  - Emergency
  - May also be a Shut Down

Cab Feed Valve

- To ensure the brake pipe pressure remains at the required level, a feed valve is connected between the main reservoir and the brake pipe
- This valve is set to specific operation pressure
- Different railways use different pressures but they generally range between 65 and 90psi.

Equalizing Reservoir

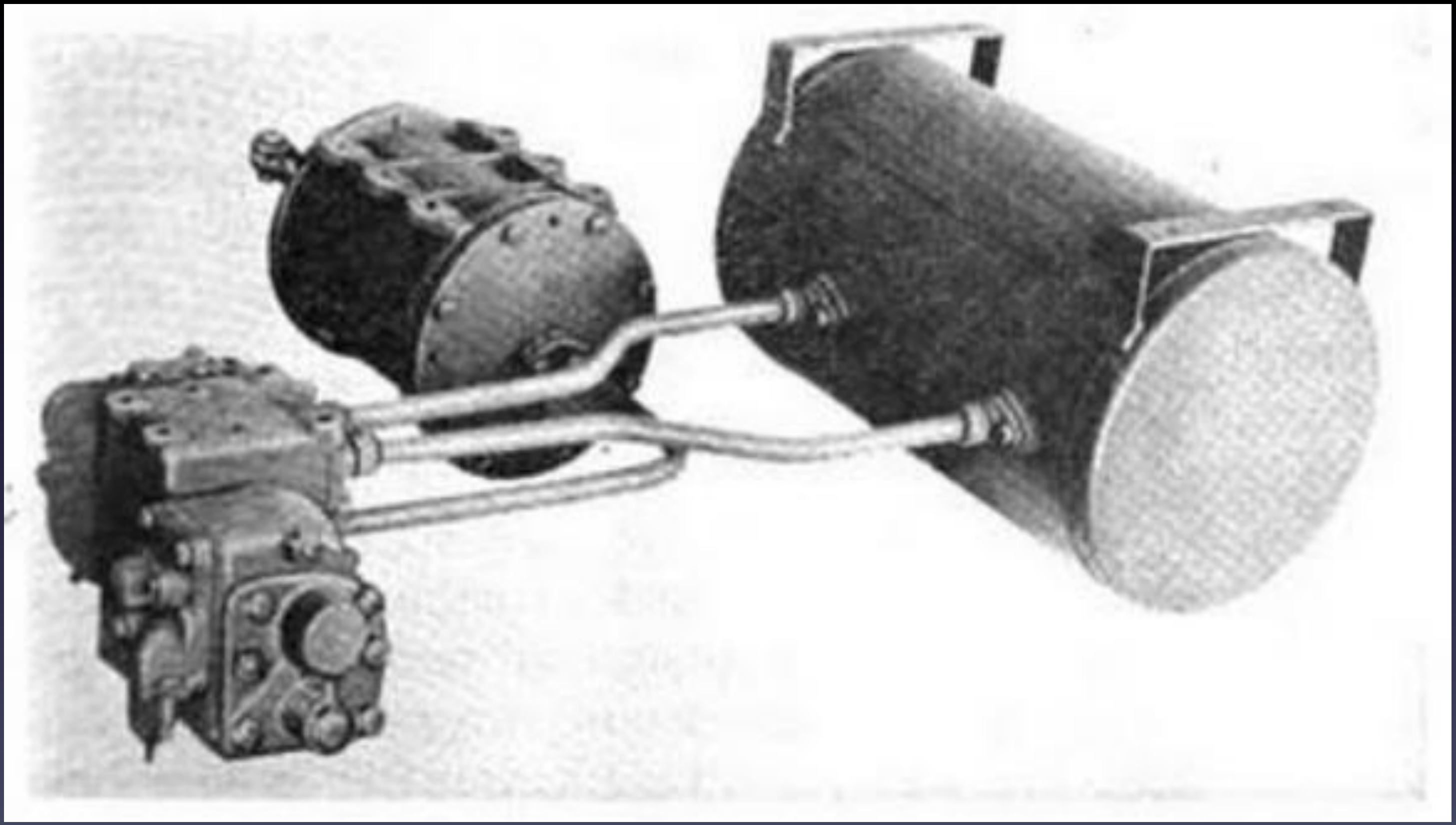
Small pilot reservoir used to help the engineer select the right pressure in the brake pipe when making an application

- Connected to a relay valve which detects the drop in pressure and lets air escape from the brake pipe until the pressure in the pipe is the same as that in the equalizing reservoir
- Overcomes the complexities of a long brake pipe. The equalizing reservoir and associated relay valve allows the driver to select a brake pipe pressure without having to wait for the actual pressure to settle down along a long brake pipe before he gets an accurate reading.

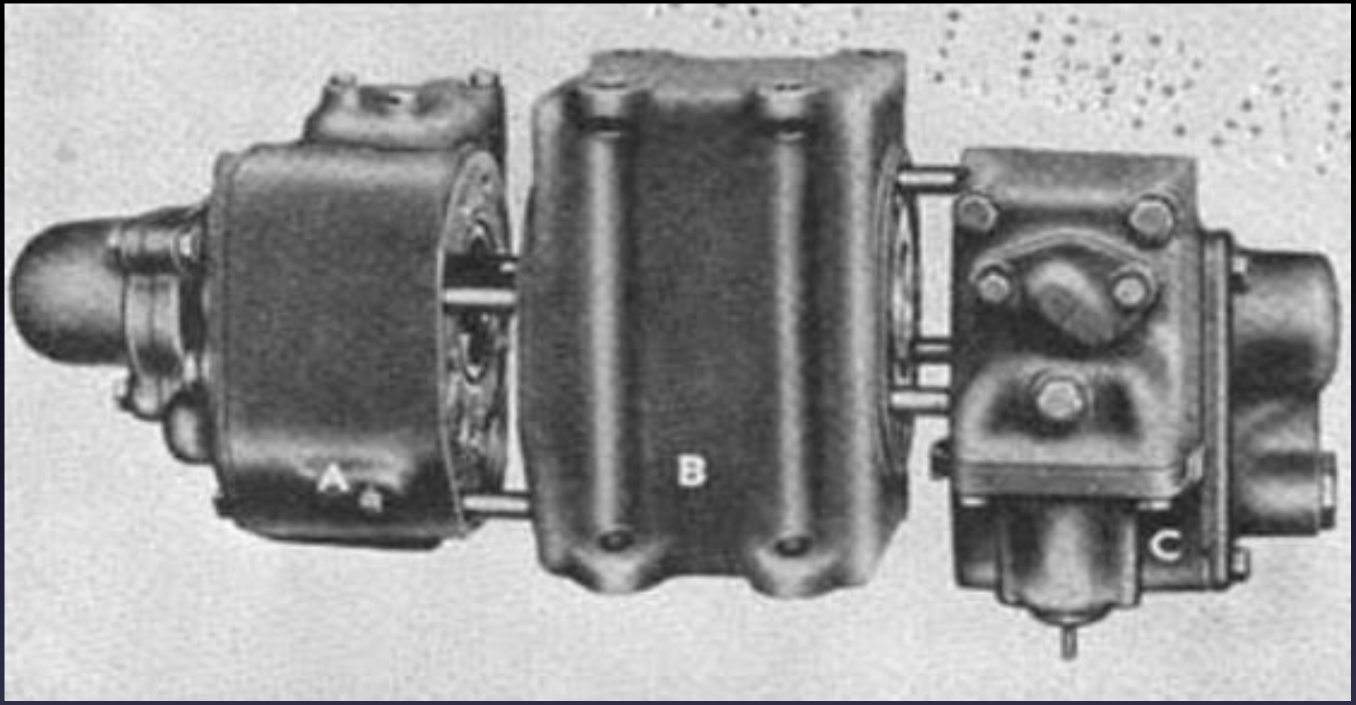
The AB Type Control Valve

- Car Brake System
- The "AB” type includes all variations of the Westinghouse AB valve, the major versions being the AB (1930) ,the ABD (1962), the ABDW (1974) and the ABDX (1989).
- The New York Air Brake have a compatible control valve, the DB-60,introduced in the early nineteen nineties.
- The Control Valve operates to apply the brakes, release the brakes and charge the reservoirs.

AB Triple Valve, Brake Cylinder and Reservoir Assembly



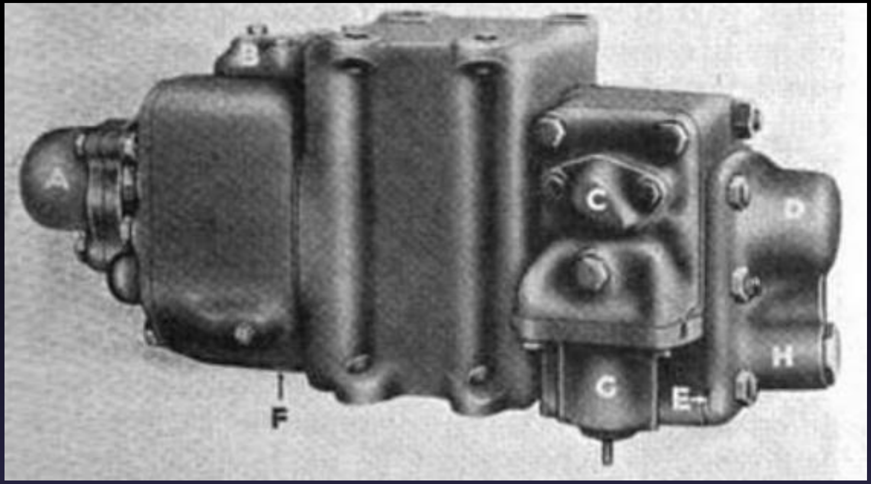
Major Parts of the Valve

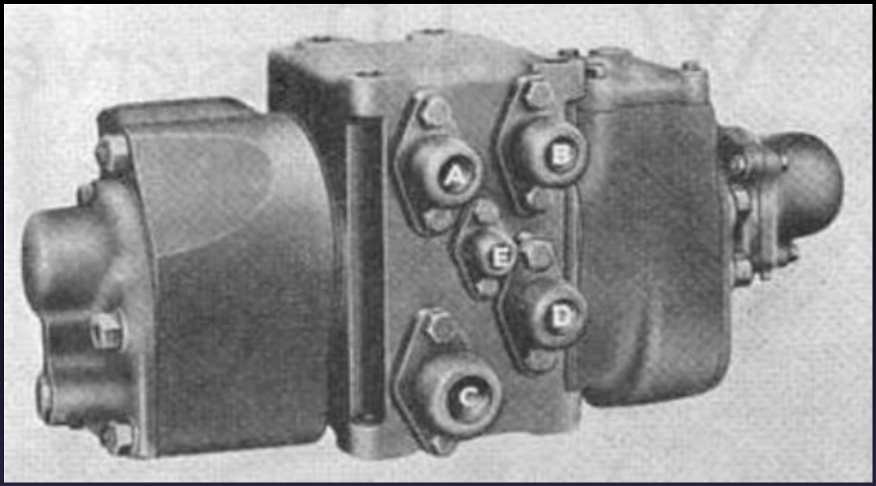


A-Emergency portion
B-Pipe Bracket
C-Service Portion

AB Control Valve

Weight 500 lbs.

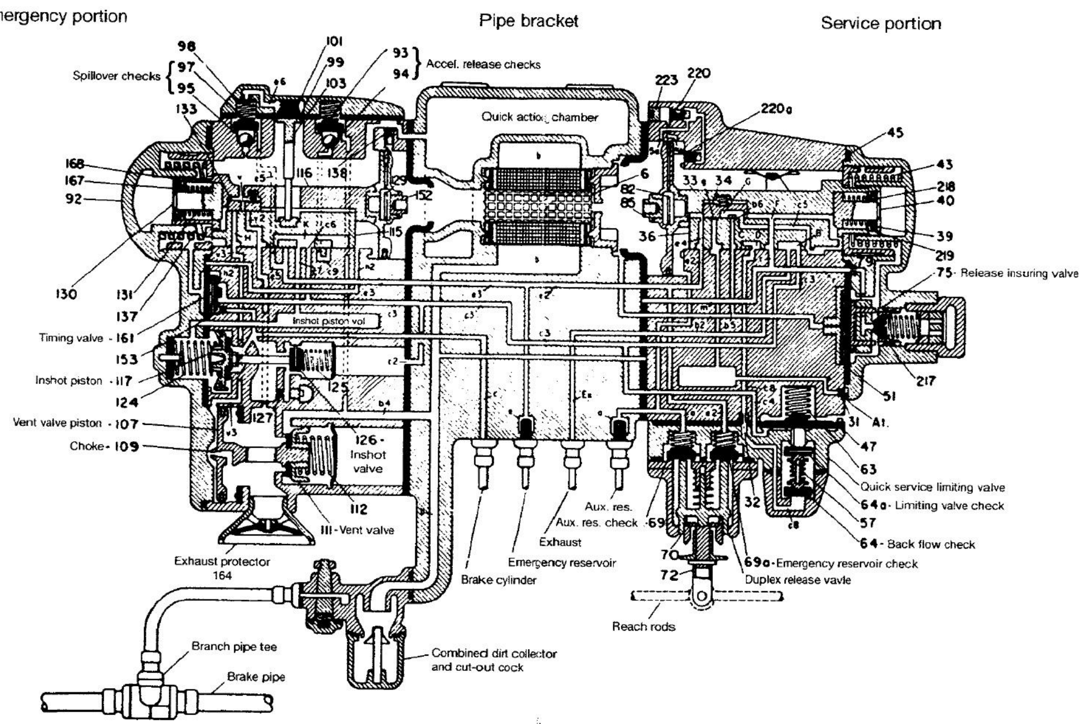




A-Accelerated Emergency Release Cap
B-Cover
C-Quick Service Limiting Valve
D-Release Insuring Cap
E-Quick Service Volume Exhaust
F- Quick Action Exhaust
G-Duplex Release Valve
H-Release Insuring Valve

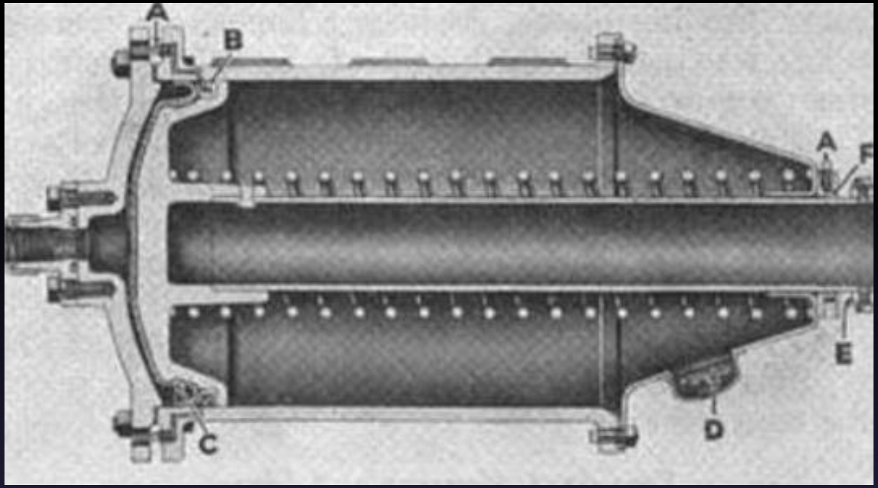
A-To Auxiliary Reservoir
B-To Emergency Reservoir T
C-To Brake Pipe
D-To Brake Cylinder
E-To Retaining Valve

Car Brake Valve



33. Service piston
34. Graduating valve (service)
36. Slide valve (service)
92. Emergency portion back cover
99. Emergency ball-check cover gasket
103. Slide valve strut
115. Emergency slide valve
116. Emergency piston
130. Emergency piston (stabilizing) spring guide
131. Emergency piston
133. Graduating valve
137. Return spring
138. Choke
220. Choke

Brake Cylinder

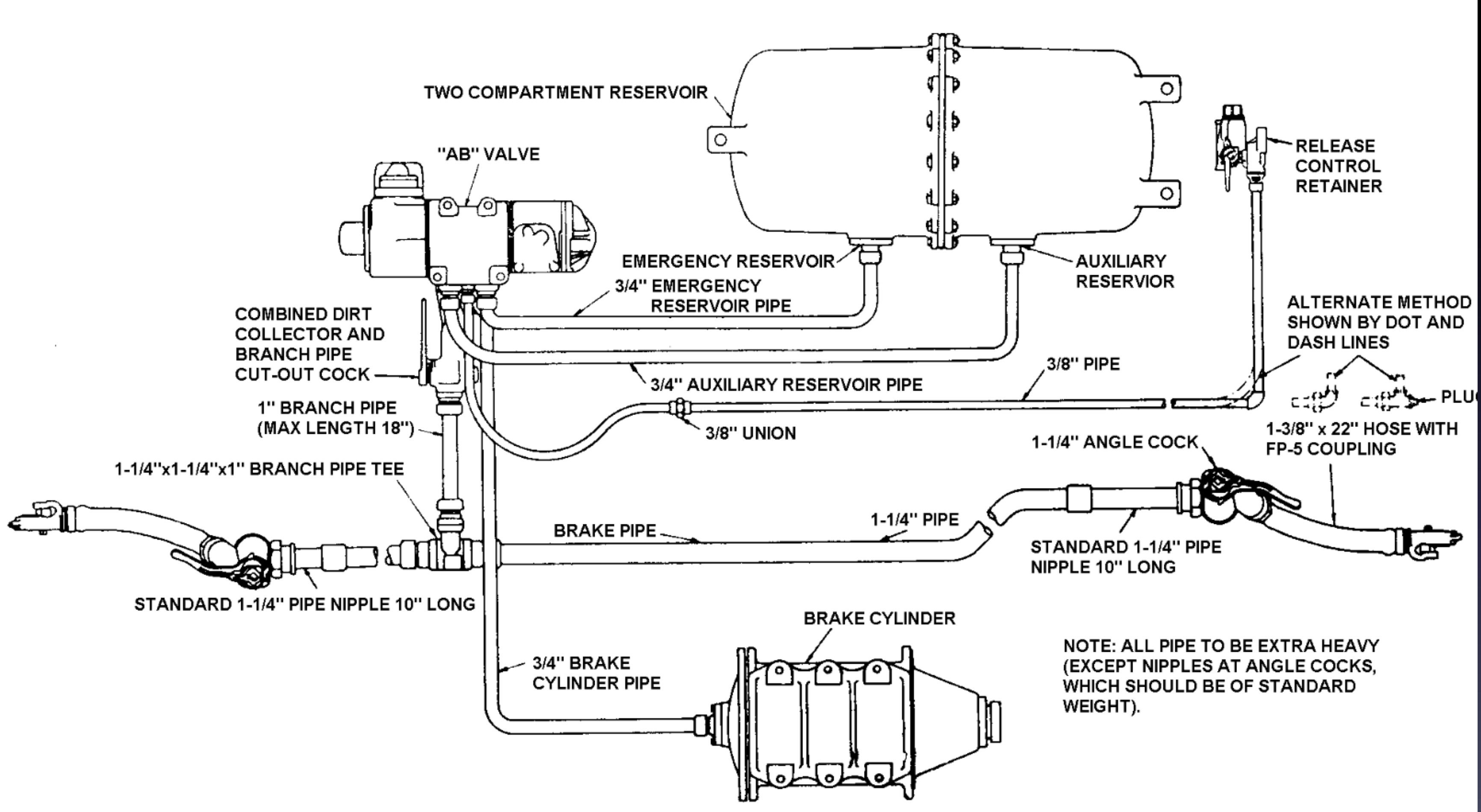


A-Connection for Lubrication
B-Felt Swab
C-Snap-on Cylinder Packing
D-Hair Strainer
E-Protecting Sleeve
F-Metallic Packing

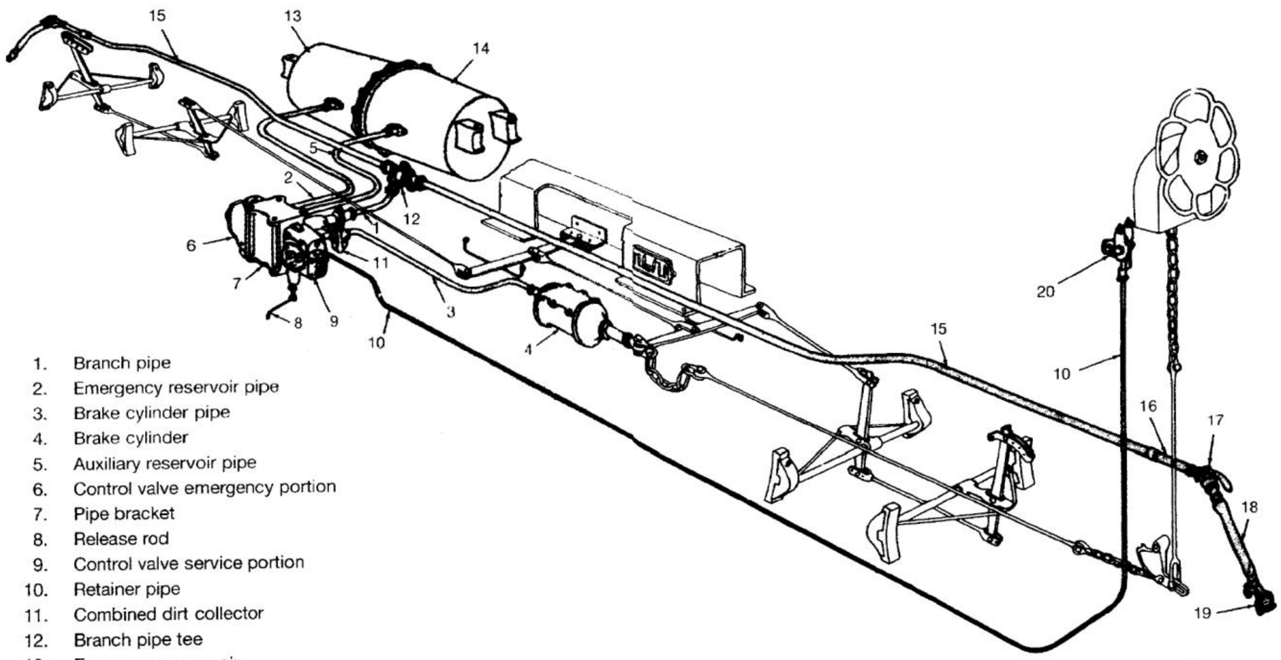
Angle Cocks and Coupled Hoses

- At the end of each car there are angle cocks, a manual valve which allow the car brake pipe to be sealed when the car is uncoupled from the train
- There is also a retainer valve, now rarely used to control each cars brake manually.
- The brake pipe is connected between adjacent vehicles through flexible hoses.

Major Components



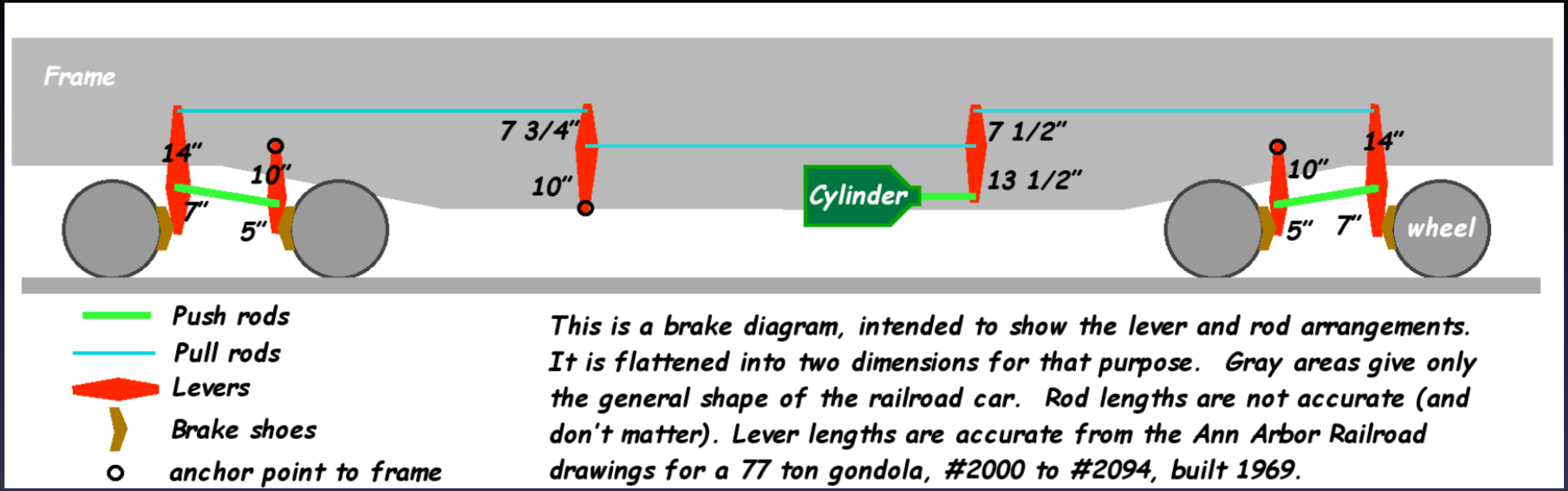
AB Equipment applied to a boxcar



1. Branch pipe
2. Emergency reservoir pipe
3. Brake cylinder pipe
4. Brake cylinder
5. Auxiliary reservoir pipe
6. Control valve emergency portion
7. Pipe bracket
8. Release rod
9. Control valve service portion
10. Retainer pipe
11. Combined dirt collector
12. Branch pipe tee
13. Emergency reservoir
14. Auxiliary reservoir
15. Brake pipe
16. Brake pipe nipple
17. Angle cock
18. Air brake hose
19. Air hose coupling "glad hand"
20. Retaining valve

Fig. 1. AB equipment commonly applied to a boxcar

Brake Rod and Lever Diagram



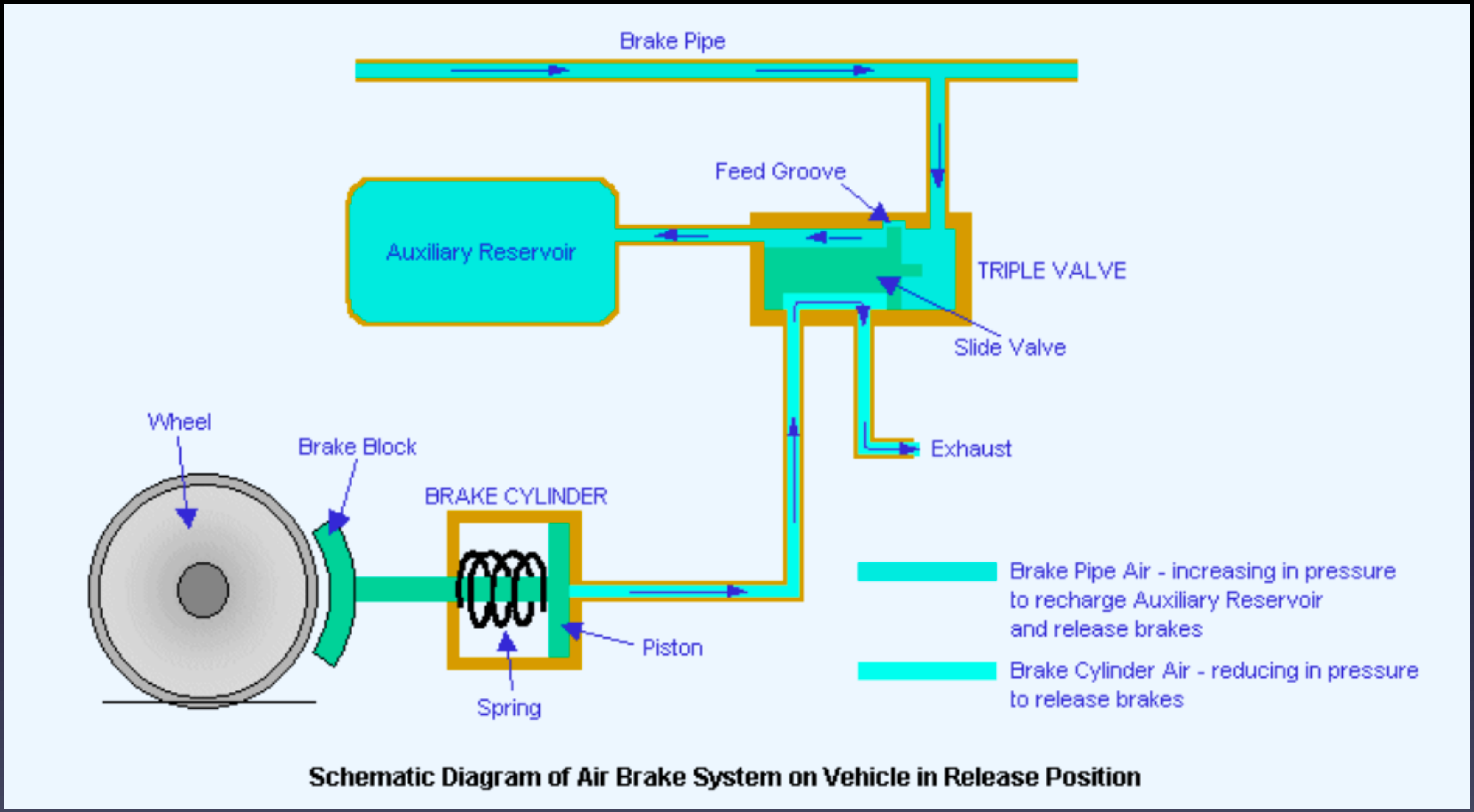
Activating the Brakes

- Air tank on each car – charged to 90psi (nominally)
- Air sent throughout the train via the brake line
- Cars connected though hose between the cars
- Engineer activates the brakes by bleeding air OUT of the brake pipe
- Reduction in pressure cause a valve on each car to CONNECT that car’s auxiliary reservoir air to the brake cylinder on that car
- Brake cylinder action is amplified mechanically via rods and levers
- The levers are linked to the brake shoes which are pushed against the wheel creating friction to slow or stop the wheel’s rotation.

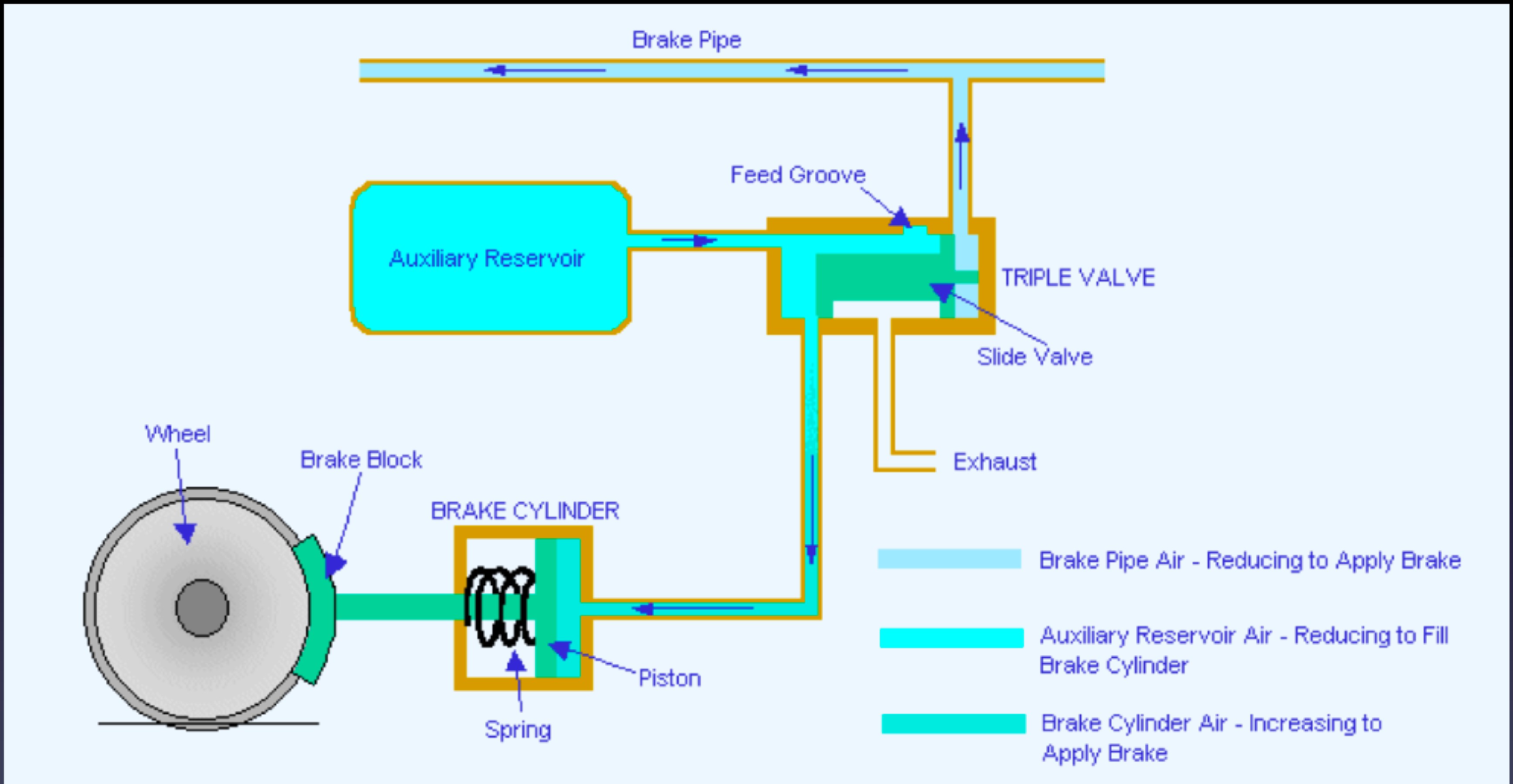
Releasing the Brakes

- Engineer moves the cab valve to the Release Position
- This sends compressed air back through the train.
- Increase in pressure cause the car valve to vent the air in the brake cylinder to the atmosphere
- A spring in the brake cylinder causes the brake shoe to move away from the wheel.

Brake Release

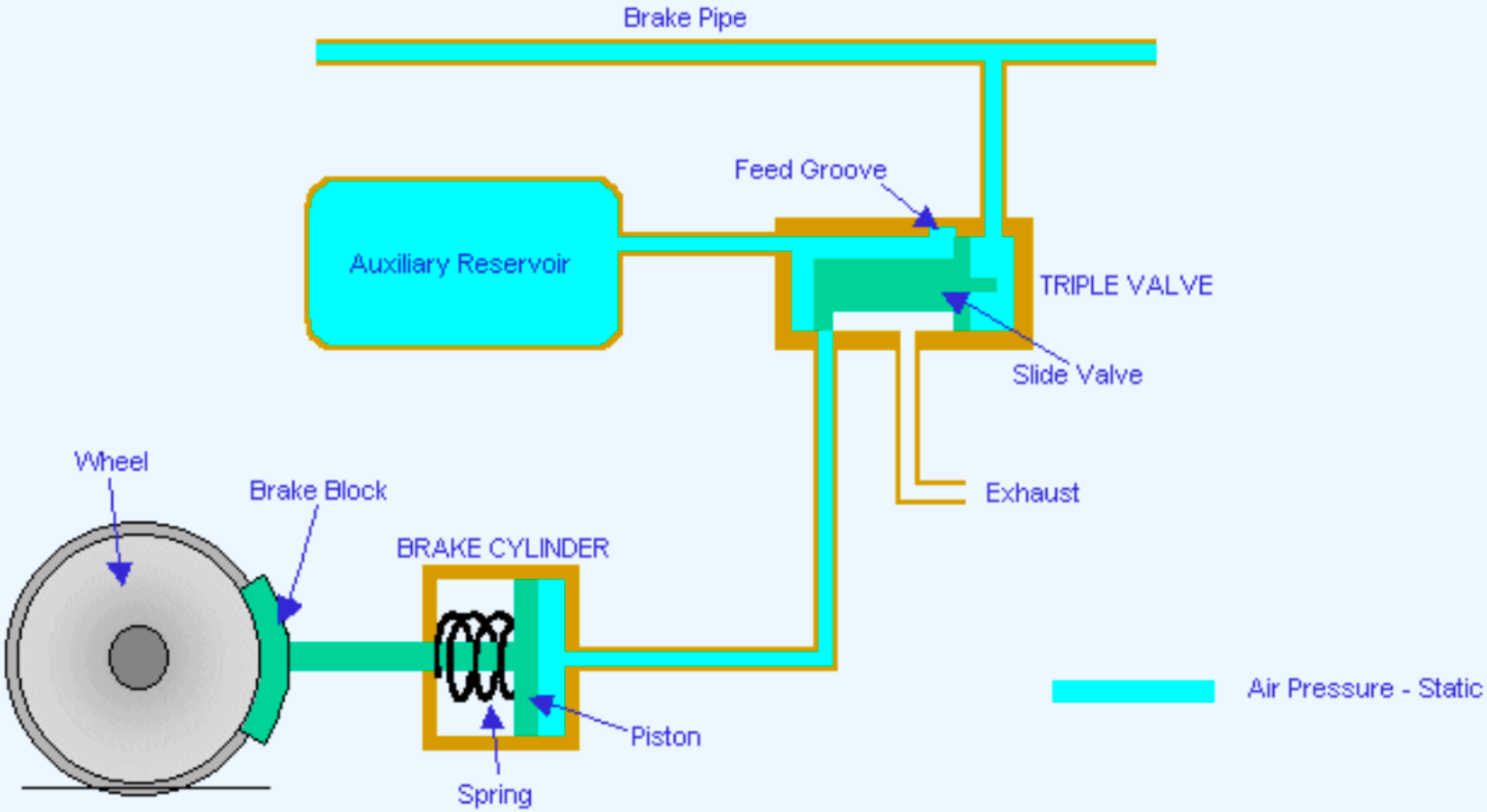


Brake Application



Schematic Diagram of Air Brake System on Vehicle in Application Position

Lap



Schematic Diagram of Air Brake System on Vehicle in Lap Position

Train Control

- Engineer can “graduate” the brakes in a more brake direction
- Any release must be a full release.
- Much different that braking on an auto
- Don’t set too much brake, or the train will stop short. Start out easy.
- If too little brake, more can be added if there is time
- If there isn’t time, the engineer is fired or dead.

Example

- Lets use the term, “made a 10 pound set”
- This means when watching the gauges, the engineer activate the brakes to the Application position. Upon reach 80 PSI he sets the lever to the Lap position sealing the brake pipe (no air in, no air out).
- At the car, as soon as the brake line pressure dropped below the auxiliary reservoir pressure the control valve moved to the apply position allowing reservoir air to flow into the brake cylinder. Of course this reduces the pressure in the reservoir to that of the brake pipe.

Let’s keep going

- Lets assume the engineer now needs to make another brake Application and lowers the pressure in the brake line by another 5psi.
- The triple valve senses the change as in the previous example and now the pressure in the brake cylinder raises to 36.5psi.
- When the brakes are no longer needed, the engineer returns the cab lever to the release and charge position. The connects the engines compressor to the brake line slowly raising the pressure back to 90psi.
- As soon as the car control valve senses the pressure increase in the brake line, is higher than the auxiliary reservoir, it moves to the RELEASE position and releases the pressure in the brake cylinder to the atmosphere. Simple huh!!

Example Continued

- **<u>Remember</u>**, the triple valve always compares the pressure from the brake pipe to the pressure in the reservoir. When the pressures match (80psi), the triple valve moves to the Lap position.
- All of the air that flowed into the brake cylinder has been applied to activate the brakes on every car.
- The volume of the auxiliary reservoir is about 2.5 times the volume of the brake cylinder so using the laws of physics, the 10psi reduction in the pressure of the reservoir results in a 25psi pressure in the brake cylinder.
- Isn’t science wonderful!!!

Complications

- In the example, the engineer applied two actions of a total of 15psi
- If very quickly, another 10psi application of the brakes is necessary, then the pressure in the brake line gets to 80psi but the car auxiliary reservoirs are slowly recharging and may be only slightly higher in pressure than their previous state. So now the car control valve sees the brake line higher than the reservoir, and no air is sent to the brake cylinder.
- Another 5psi application now will result in only a very low pressure in the brake cylinder. Not much braking left.

Broken or Separated Air Hose

- Brakes apply whenever the pressure in the brake line drops
- If a car accidentally uncouples, brake will apply fully since all of the air in the pipe is vented to the atmosphere immediately.
- Hence AUTOMATIC Air Brakes

Pissing away the Air

- Imagine when going down long mountain grade, an unskilled engineer make several heavy sets and releases in a short time
- There will soon be no brakes because there will be very little air left in the auxiliary reservoirs.
- Engineers refer to that result by the title of this slide.

No Air, No Brakes

- A car has no air brakes until each car reservoir is initially charged by the locomotive or a charging line in the yard.
- The brakes must be set manually if there is no air in the reservoir.

Emergency

- On a long train, the brake pipe is very long and will be slow to react to the drop in pressure triggered in an emergency.
- An emergency vent valve is installed in every car's control valve.
- If the pressure in the brake line drops quickly, the emergency valve opens the cars brake line stub to the atmosphere.
- In an emergency, all the engineer has to do is vent the brake line at the engine end and the next car will go into emergency and set the brakes and sequentially, all of the cars in the consist will do the same. Same thing if a coupling hose is broken for any reason

Emergency Reservoir

- To insure that there is always enough air pressure in each car for an emergency application, there is a second “emergency” reservoir on each car. When the action from the previous slide takes place, the 90psi in the emergency reservoir is fully applied to the brake cylinder in combination with the car’s reservoir assuring full braking.
- When the engineer activates an emergency, all of the air in the brake line evacuates out of a large hole on the cab control valve. This is referred to as a “Big Hole ‘em” action.

Retainers

- Early application before dynamic engine brakes
- Retainer Valve existed on most earlier freight cars
- Retainer valve is mounted on the exhaust pipe of the brake cylinder and is located on the exterior side of the freight car
- Valve has four operating positions; direct release, slow release, low pressure hold and high pressure hold.
- At the top of a long grade, the brakeman would operate the retaining valve on each car, (just enough to control the train)
- At the bottom, the brakeman has to return the valve to it’s direct release condition.

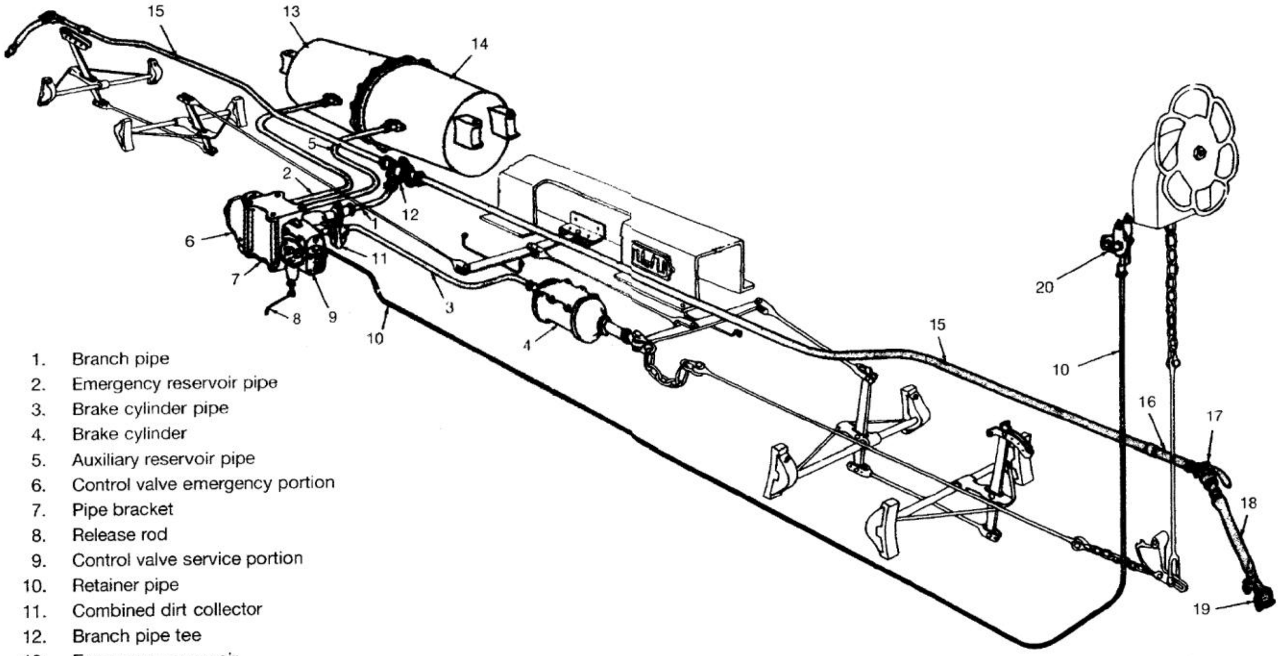
Engine Dynamic Braking

- Modern diesel engines Have the unique ability to control the power being applied to the traction motors that drive the train.
- While the train is coasting, an eight notch brake (similar to the throttle) energizes the traction motor field causing the motor to become generators. The resistance of the motor field act like a brake on the locomotive. The heat of this action is dissipated as heat in banks of resistors located in the engine car body.
- Dynamic braking is not a substitute for air brakes but it is an additional means of speed control.

Applying all of this to modeling

- A real test of prototype modeling is how well you apply the components of air brakes to the underbody of your car fleet.
- Ready to roll cars generally (but not always) have the major components molded into the underneath section car body
- Scale is again a determining criteria

AB Equipment applied to a boxcar



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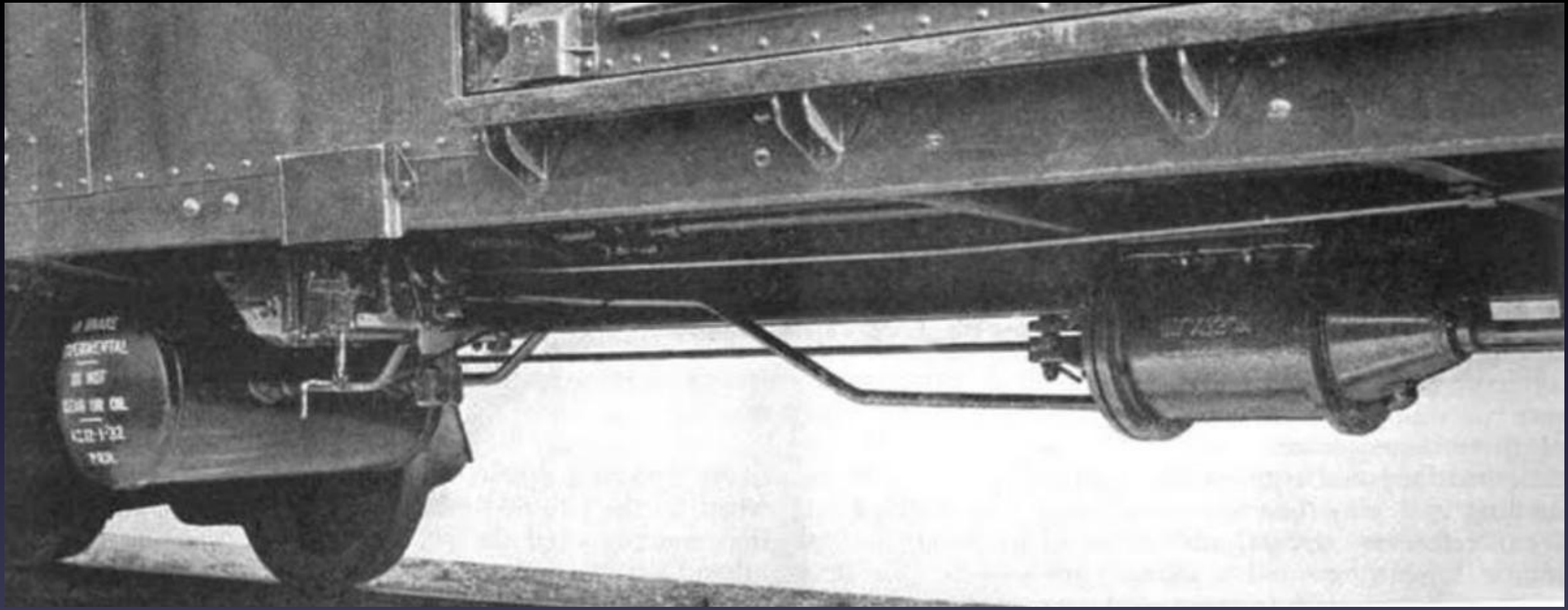
Prototype View



Major Required Parts

- Emergency/Auxiliary Reservoir
- Control Valve
- Brake Cylinder
- Brake Pipe
- Brake Wheel
- Rods and Levers ????

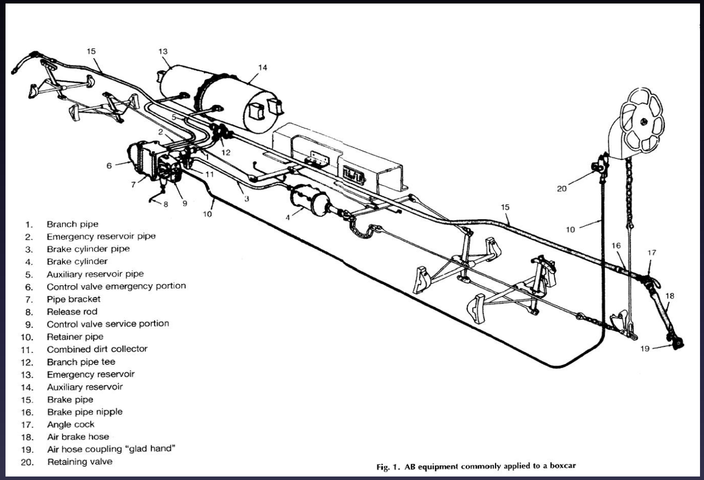


Fig. 1. AB equipment commonly applied to a boxcar

Model Application

PIPING

Train line 1¼" OD
Brake Cylinder ¾ " OD
Branch Pipe ¾" OD
Emergency Reservoir ¾" OD
Auxiliary Reservoir ¾" OD
Retainer line 3/8" OD

RODDING

Varies from 7/8" OD to 1¼" OD, the rods connecting the two levers and cylinder being ¼" larger than the other rods.

LEVERS

Vary in both length and width, with the lever at the brake cylinder averaging 36" - 48" and the floating lever 30" - 36". Both levers are from 6" - 8" at the widest point and 2" - 3" at the ends.

Size Really Matters

- O & HO Scale – Several well known parts manufacturers produce most everything needed
- N Scale – very limited number of small manufacturers produce the bigger parts Out of stock problems abound
- Z scale – Quite probably impossible to get cast parts but possible to simulate parts out of styrene.
- Brass rod available for brake lines down through N scale
- Brake wheels readily available in all scales

Scale Resource Examples

- Z Scale (forget it)
- N Scale
  - Precision Scale 6713 Brass Wabco AB Kit
- HO Scale
  - Tichy Train 3013 AB Brake Set Plastic
- O Scale
  - San Juan Car Co. 5102 AB Brake Set
- On30
  - Wiseman Back Shop K 1015 AB Brake set
- On3
  - Grandt Line On3 Westinghouse Set 3-22

Next Time

- The next time you kit bash or scratch build a freight car, make sure you pay full attention to the brake details. We'll all be looking.

Wrap Up

- Any Questions