CHAPTER 4

EMERGENCY STOPPING SYSTEMS

REVISED FEBRUARY 2008

TABLE OF CONTENTS

CHAPTER 4

REVISE OCTOBER 1992 EMERGENCY STOPPING SYSTEMS

1. INTRODUCTION. This chapter applies only to those vehicles which use compressed air for applying the service brakes at the wheels. Exceptions in the requirements are listed in subsections (m) and (n) of Vehicle Code Section 26508. The inspection procedures and information contained in this chapter are intended to establish a uniform procedure for the inspection of emergency stopping systems to determine compliance with the Vehicle Code and clarify the requirements of Section 26508. Definitions of terms used in this chapter are contained in Annex A.

2. TYPES OF EMERGENCY STOPPING SYSTEMS. The three basic types of emergency stopping systems in use are listed below:

a. Spring-Applied Systems. Commonly known as spring brakes.

b. Air-Applied Systems.

(1) No bleed-back relay emergency valve.

(a) Commonly used on Pre-1975 trailers.

(b) May be encountered on buses and on some pre-1964 motor vehicles of other types.

(c) New designs introduced during mid-1980s as retrofit replacements for spring-applied systems.

(2) Axle-by-Axle protected air brakes.

(a) Will have a separate air tank for each axle except vehicles manufactured prior to 1964 may or may not be so equipped. (Section 26508(c), (j) VC).

(b) Used only on motor vehicles.

(3) Dual treadle valve systems (a form of axle-by-axle protected air brakes).

(a) Sometimes referred to as split systems or dual circuit systems.

(b) Used only on motor vehicles.

c. Mechanical Systems.

(1) Usually consist of a conventional lever-operated parking brake.

(2) May be connected to a drive shaft or wheel brake assembly.

3. GENERAL.

a. Most Common Type of Emergency Stopping System in Present Use. The most common type of emergency stopping system in present use on motor vehicles is the spring brake system.

b. Most Common Type of Emergency Stopping System Prior to 1975. The most common type of emergency stopping system in use prior to 1975 on towed vehicles was the no bleed-back relay emergency valve system. Towed vehicles manufactured on or after January 1, 1975 under FMVSS 121 usually have spring-applied emergency stopping systems because they are required by the FMVSS to hold indefinitely after emergency application.

c. Mechanical System. The mechanical system normally installed on the drive shaft or connected to the rear axle brakes on motor vehicles will meet the design and operational requirements of Section 26508 VC for motor vehicles operated singly but will not meet the stopping distance requirements of subsection (k) of Section 26508 VC under most conditions.

d. Special Systems. Occasionally, special systems, which are in most cases variations of spring-applied or air-applied systems, will be encountered. The difference usually is in the method of manual or automatic application of the system. However, some motor vehicles which were manufactured prior to 1964 are equipped with relay emergency valves with separate air tanks for each axle and some have axle-by-axle protected air brakes with a separate air tank for each of at least two axles. When these systems are encountered, care must be exercised to determine if the system is properly installed and if it meets the requirements of the Vehicle Code.

e. Aftermarket Supplemental Emergency Stopping Systems.

(1) Supplemental equipment for emergency stopping of runaway vehicles may be found on some commercial vehicles. These devices are not legal substitutes for those systems that are required by the Vehicle Code or any regulation, however, there are no laws or regulations that prohibit their installation in addition to required equipment.

(2) Inspection of these devices should be restricted to conditions likely to affect the safe operation of the vehicle, such as worn or defective application controls that could cause the device to stop the vehicle or combination unexpectedly.

(3) Figure 4-1 shows one type of system that may be encountered. This device will stop a vehicle or combination, but is not a true brake. This is why this discussion uses the term "emergency stopping system".

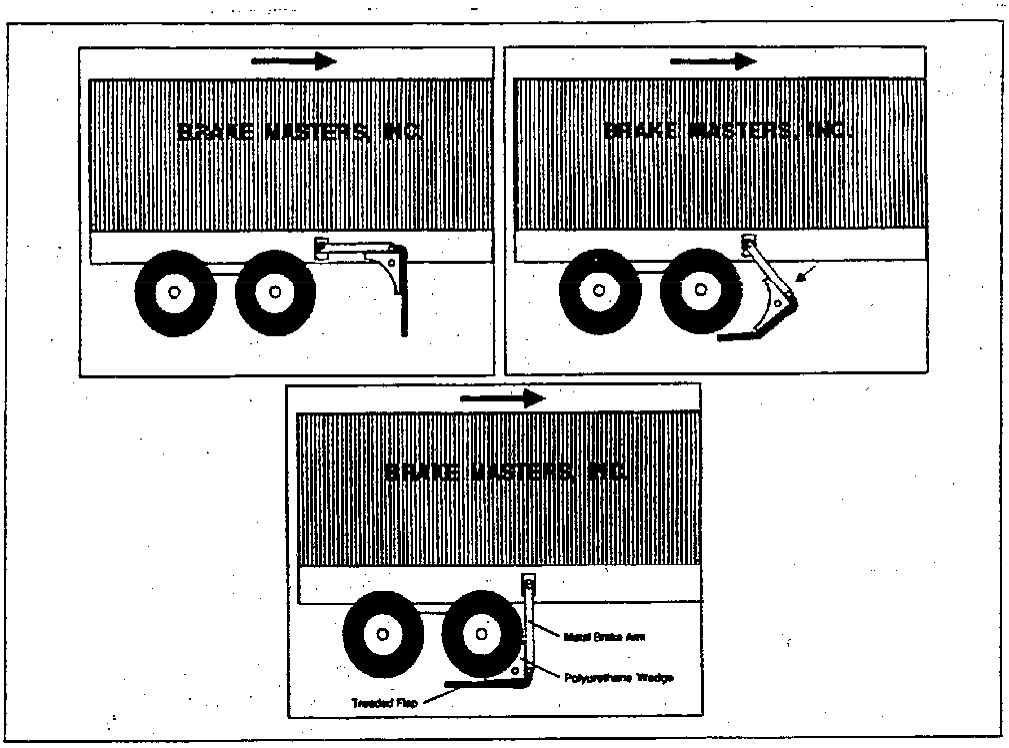

Fig. 4-1. Brake Masters, Inc. "Emergency Brake System (EBS)"

4. SYSTEM DESCRIPTIONS.

a. General. The emergency stopping systems depicted in the following illustrations are representative of those in current use. A brief explanation of how the systems function has been included below each illustration.

b. Spring-Applied Emergency Stopping Systems on a Motor Vehicle. Figure 4-2 shows a spring-applied emergency stopping system on a two-axle motor vehicle with spring brake actuators on the rear axle.

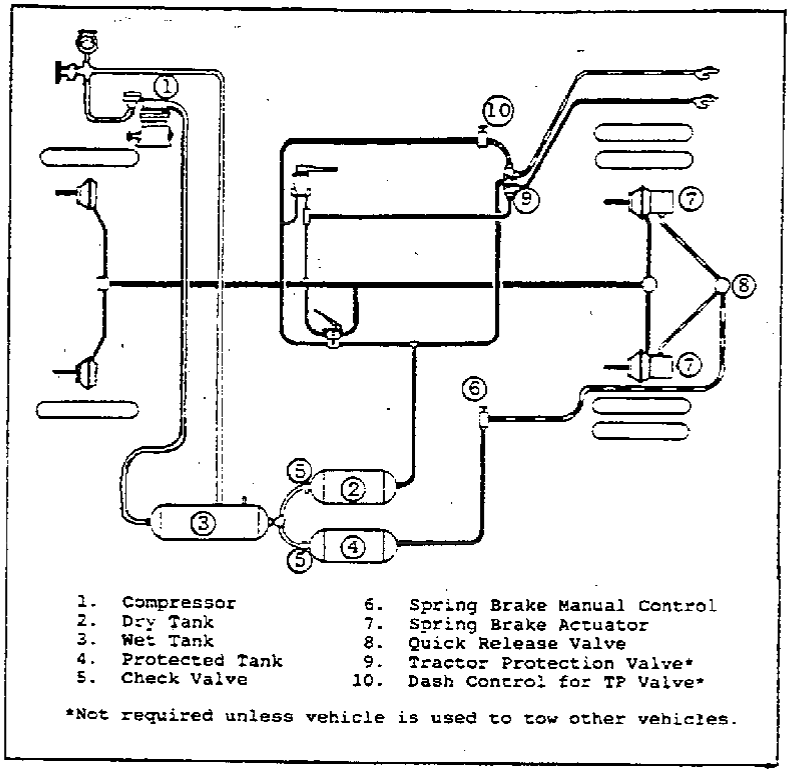

Fig. 4-2. Spring-Applied Emergency Stopping System

(1) Description. The emergency system consists of the spring brake actuators, a dash-mounted spring brake control valve, a protected air reservoir, a check valve for the protected air tank, and the attendant piping.

(2) Operation. The protected reservoir draws its air from between the wet and dry reservoirs and is protected against backflow through the service brake system by a check valve at the inlet of the reservoir. Air pressure from the protected reservoir feeds through the dash-mounted control valve and holds the springs in the brake actuators compressed. Application and release of the spring brakes are controlled by the dash-mounted control valve. This system will not operate automatically if the air in the service brake system is exhausted. There is no California requirement that the emergency stopping system of a motor vehicle apply automatically.

c. Air-Applied Emergency Stopping Systems with DD3 Brake Actuators. Figure 4-3 shows an air-applied emergency stopping system on a two-axle motor vehicle using DD3 type brake actuators on the rear axle.

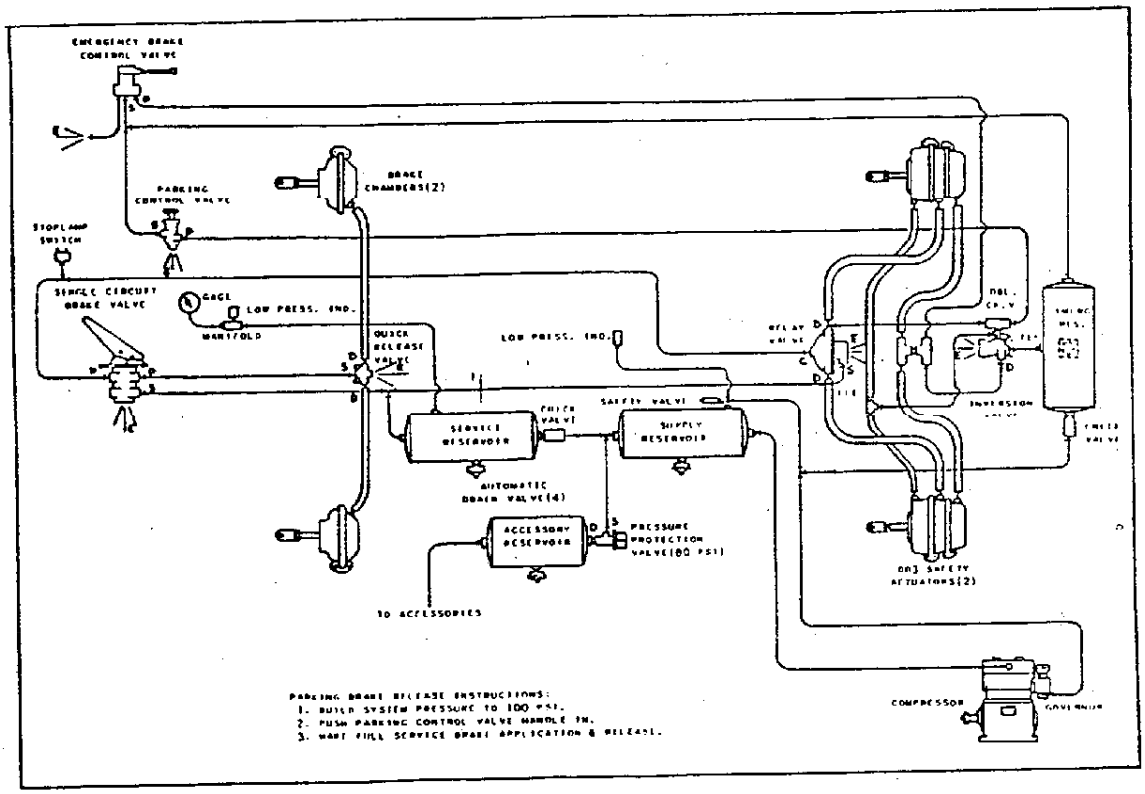

Fig. 4-3. DD3 Air-Applied System

(1) Description. The air connection nearest the slack adjuster on the DD3 actuator feeds air to an internal mechanical locking device to hold it in the released position during normal operation. The center connection ,functions with service brake operation, and the rear connection functions in conjunction with the front connection to meet the emergency stopping system and parking. brake requirements. This system was designed for motor vehicles operated singly and, without modification, will not meet the requirements for motor vehicles used to tow other vehicles. It is most commonly found on buses.

(2) Operation. Operation of the DD3 actuator is explained in paragraph c., pages 4-14 and 4-15.

d. Air-Applied Emergency Stopping Systems with DD2 Brake Actuators. Figure 4-4 shows an air-applied emergency stopping system on a three-axle motor vehicle with DD2 brake actuators on the rear axle.

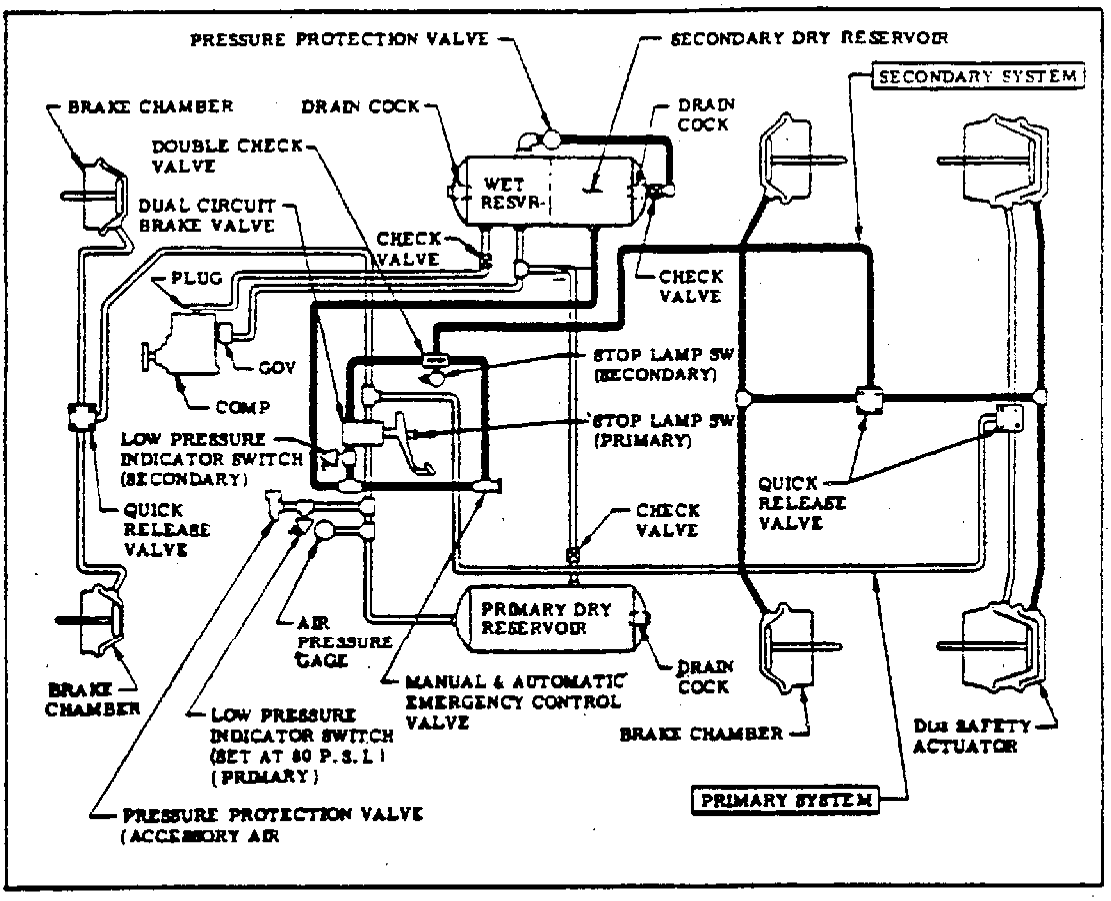

Fig. 4-4. DD2 Air-Applied System

(1) Description. The above illustration shows a dual circuit service and emergency braking system. The system is designed so that failure in either system will not leave the vehicle without brakes on at least one axle. This is accomplished through the use of a dual treadle valve and double diaphragm (DD2) brake actuators with a protected air supply. The system may be installed to be manually or automatically applied. In this particular design, the system is installed to serve as a service and emergency braking system and may be manually or automatically applied. It does not meet parking brake requirements because it is not. held in the applied position by mechanical means.

(2) Operation. Both circuits of this system operate with each .application of the treadle valve. In addition, the DD2 actuators are installed to operate with the dash-mounted or manual control valve application. Operation of the DD2 actuator is explained in paragraph e., pages 4-18 and 4-19.

e. Air-Applied Emergency Stopping Systems with International Transquip Industries (ITI) Brake Actuators. Figure 4-5 shows and ITI brake actuator.

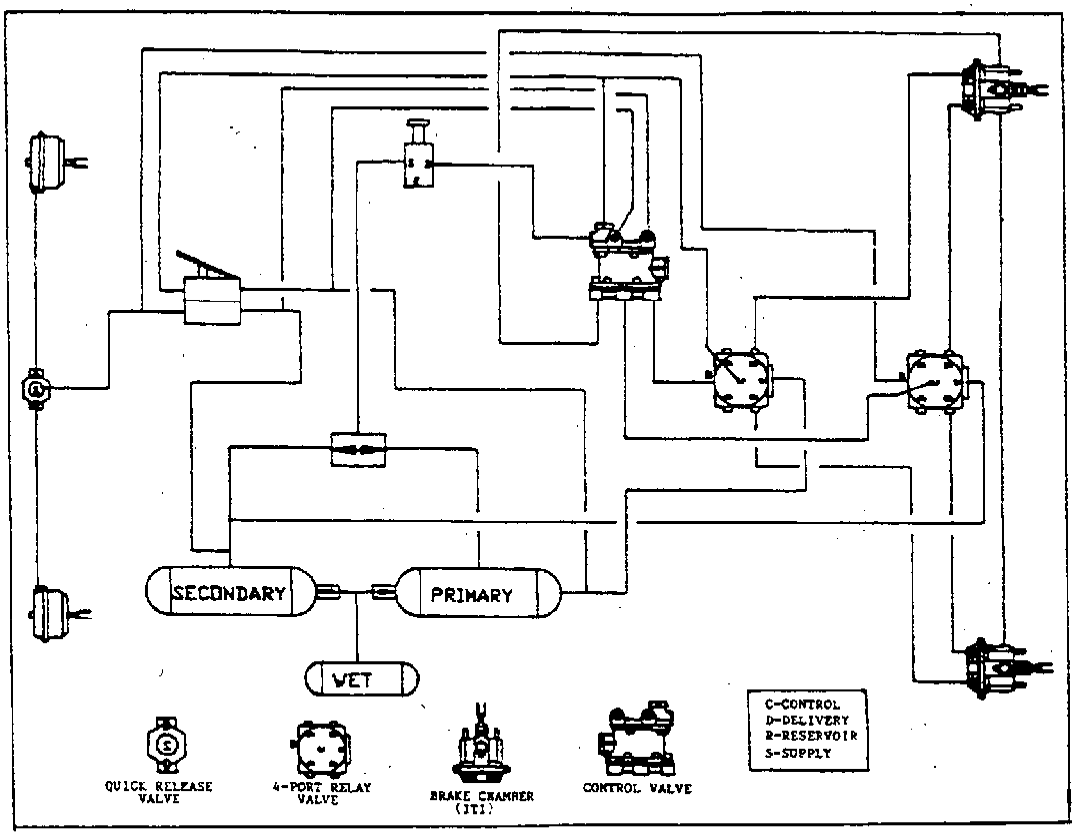

Fig. 4-5. ITI Air-Applied System

(1) Description. The ITI chamber is an air-actuated, mechanically held parking, emergency, and service chamber with functions similar to the DD3 chamber. Air from the parking brake control (push-pull) valve is used to signal the ITI control valve to apply and release the parking brakes. In the absence of substantial air pressure in the emergency line, the control valve will exhaust the air from the piston chamber and apply air to the service chamber in direct relation to the emergency line pressure. 'This sequence will mechanically lock the service actuators in the park position.

(2) Operation. Operation of the ITI actuator is explained in paragraph f.(2), page 4-21.

f. Dual Circuit System with Spring and Air-Applied Brake Actuators. Figure 4-6 shows a dual circuit service and emergency braking system with spring and air-applied brake actuators on a two-axle motor vehicle. The dotted lines indicate additional equipment for motor vehicles which are used to tow other vehicles.

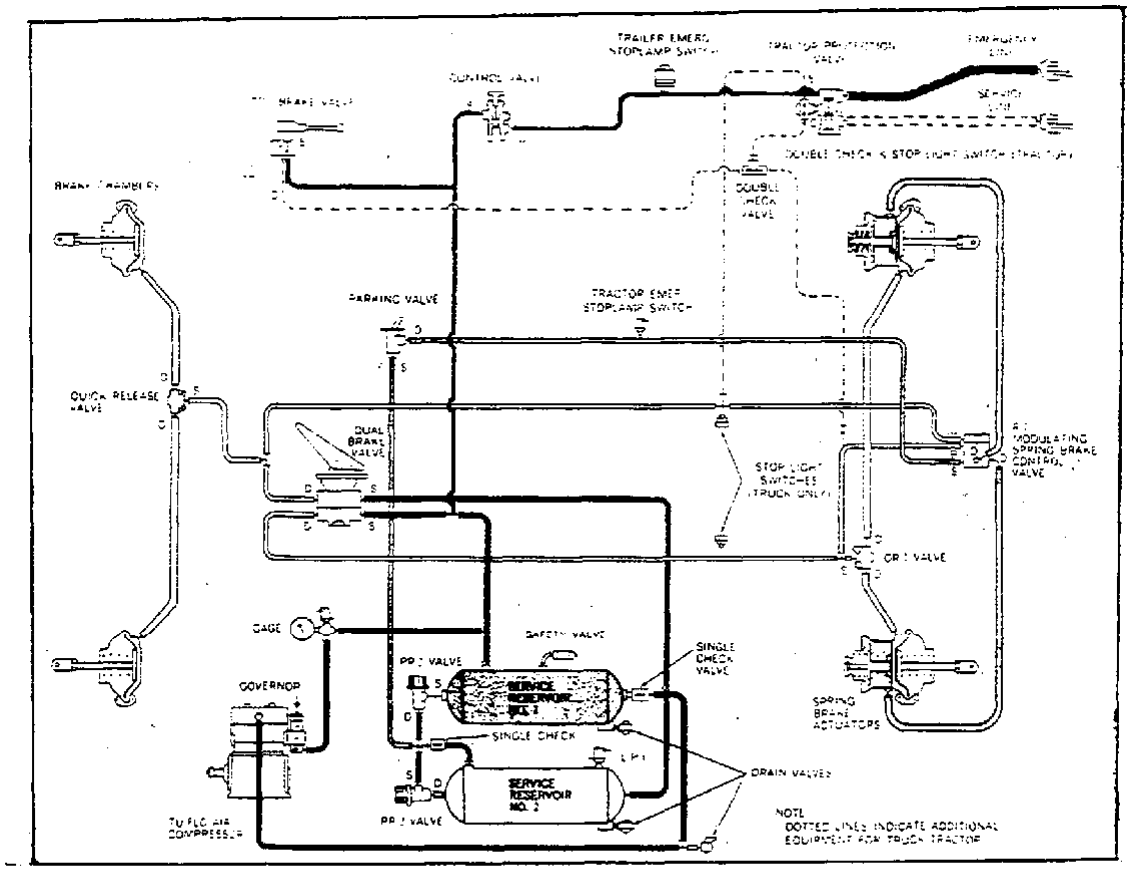

Fig. 4-6. Dual Circuit Spring and Air-Applied System

(1) Description.

(a) Service Brakes. The service brakes in this system are split acro the dual treadle valve to supply the rear axle from the primary circui and the front axle from the secondary circuit. The trailer service brakes normally are supplied by both circuits via a double check valve The trailer service system is, therefore, still a single-circuit system

(b) Emergency Brakes. The emergency brakes are considered to be the remaining intact circuit of the dual circuit system. In one system manufactured by Ford Motor Co., both reservoirs are protected by pressure protection valves (PR2) so that a single failure anywhere will not exhaust both reservoir tanks. Other similar systems use single check valves instead of the pressure protection valves.

1 If the secondary brake air supply is lost, only the front axle brakes are lost; the truck or tractor rear brakes and the trailer service brakes are applied as the emergency brakes.

2 If the primary brake air supply pressure is lost, the front axle brakes and the trailer brakes can be applied, but, the rear axle service brakes cannot be applied. However, on vehicles not factory-equipped to tow other vehicles, rear axle braking is accomplished by the function of an R-7 modulating valve which exhausts the spring hold-off cavity pressure, thereby allowing the spring brake actuators to apply under the modulated control of the driver's foot valve.

(c) Parking Brakes.

1 A full parking application can be made by moving. the parking valve control handle to the "park" position which exhausts the R-7 modulating valve supply and the spring hold-off cavities of the spring brake actuators.

2 If a service application is made when the spring brake actuators are in the applied position (spring hold-off cavities vented), the double check valve in the R-7 modulating. valve allows recharging the spring hold-off cavities, thereby preventing compounding of push rod forces. This prevents overstressing of the brake mounting hardware and other components;

3 The compressor discharge is piped to the No. 1 reservoir and protected by a single check valve. The No. 2 reservoir is supplied by the No. 1 reservoir. A complete loss of air in either No. 1 or No. 2 reservoir is prevented by the PR2 pressure protection valves which are set to close automatically at a predetermined pressure level.

4 The parking control valve is supplied from a point between the No. 1 and No. 2 reservoirs to minimize automatic application of the spring brake actuators. If loss of air in No. 1 reservoir occurs, the parking brake control valve is supplied from No. 2 reservoir through the single check valve (both PR2 valves close upon loss of air in either reservoir); if loss of air in No., 2 reservoir occurs, the governor allows the

compressor to resupply No. 1 reservoir to the PR 2 pressure protection valve opening pressure. Therefore, the PR2 valve protecting No. 1 reservoir provides a supply for the parking brake control valve.. The delivery port of the parking brake control valve is piped to, the supply port of the R-7 modulating valve. Thus, with the parking brake control valve in the "release" position, the spring brake actuators are released. As stated before, the purpose of this piping arrangement is to minimize automatic application of the spring brake actuators.

5 The primary circuit of the dual brake valve is supplied by No. 1 reservoir, and the secondary circuit is supplied by No. 2 reservoir. The primary circuit actuates the rear axle service brakes and supplies the balance port of the R-7 modulating valve. The secondary circuit actuates front axle brake chambers and supplies the control port of the R-7 modulating valve. Either the primary or the secondary circuit will actuate the stoplight switch.

(2) Operation.

(a) During normal operation, the spring brake actuators are held in the released position by air pressure supplied to the parking brake control valve and the R-7 modulating valve. The parking brake control valve is supplied from either or both service reservoirs; the two sources of supply air minimize automatic applications.

(b) To park the vehicle, the parking control valve is placed in the "park" position, which exhausts the air from the spring brake actuators.

(c) During normal service braking, air from the two circuits of the dual brake valve is delivered to the R-7 modulating valve,_ and there will be no effect upon the spring brake actuators. Braking will be through the normal action of air pressure on the diaphragms of the front, rear, and trailer axle brake chambers.

(d) Should the primary circuit of the dual brake valve fail, there would be no air pressure to actuate the service brakes on the rear axle; however, the air pressure delivered by the secondary circuit of the dual brake valve to the R-7 modulating valve would cause the R-7 modulating valve to exhaust air from the spring brake actuators and provide rear axle braking as well as normal service braking to the front axle and the trailer.

(e) Should the secondary circuit of the dual brake valve fail, the primary circuit will provide normal service brakes to the rear axle and ,the trailer. The spring brake actuators and front axle brake chambers will not be actuated.

(f) If either circuit of the dual brake valve fails, a signal will be sent back to the trailer because both circuits of the dual brake valve supply the trailer service line through double check valves.

(g) The parking control valve and the tractor protection control valve serve as secondary emergency brake controls and can be actuated in the event of treadle failure.

g. Axle-by-Axle Protected Air Brakes.

(1) Description. Any vehicle manufactured on or after January 1, 1964, which uses axle-by-axle protected air brakes as the emergency stopping sytem must have a separate air tank system for each axle.

Exception: Motor vehicles equipped with a dual or tandem treadle valve system need have no more than two protected air tanks in such system, one for the service brake system and one for the emergency stopping system, each plumbed into the dual treadle valve.

Motor vehicles manufactured prior to 1964 equipped with axle-by-axle protected air brakes are not required to have a separate air tank system for each axle if a separate air tank system is provided for each of at least two axles. This system shall be deemed to be in compliance with Section 26508(e) and (f) VC, provided that each system independently meets all other requirements of Section 26508 VC..

Operation. The system shall be designed to be manually applied, released and reapplied by a person in the driver's seat and shall be capable of complying with the stopping distance requirements of Section 26508(k) VC.

The axle-by-axle protected air brake system is designed to maintain sufficient air (from a protected air reservoir) to apply the brakes on at least one axle, in the event of service air loss due to failure or malfunction in any part of the system.

h. Relay Emergency System for Trailers. Figure, 4-7 shows a typical relay emergency valve type emergency stopping system for trailers and semitrailers.

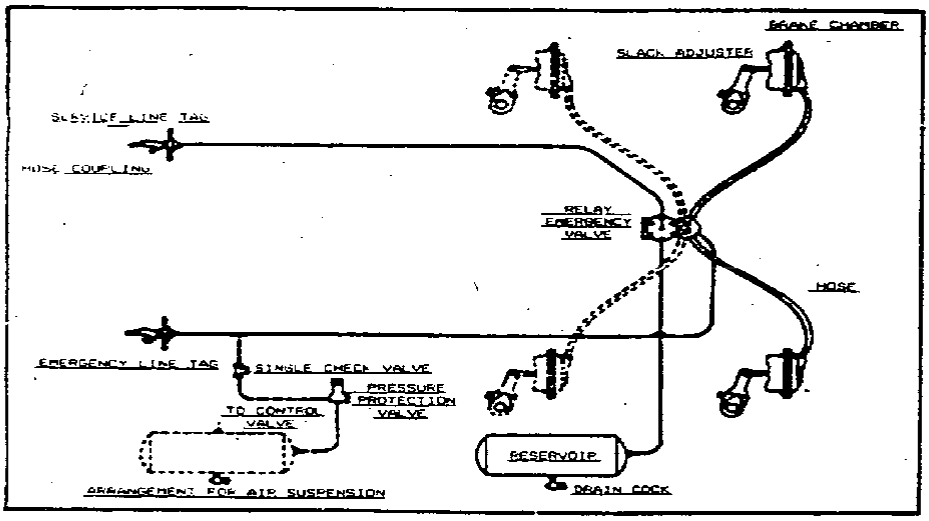

Fig. 4-7. Relay Emergency Valve System for Trailers

(1) Description. The relay emergency (RE) valve combines the functions of a relay valve and an emergency valve. It automatically applies the trailer brakes when the emergency line to the trailer is broken, disconnected, or otherwise vented to atmosphere when the trailer air brake system is charged. It is used on trailers which require an emergency brake application upon breakaway from the truck or tractor. Some RE valves are mounted directly on the trailer reservoir, while others are mounted away from, but connected to, the trailer reservoir by tubing. Both valves operate in a similar manner. They are typically found on trailers not subject to FMVSS 121.

(2) Operation. The relay emergency valve serves several important operating functions in the air brake system.

(a) When a tractor is connected to a trailer and the service and emergency lines are opened, the relay emergency valve permits charging the trailer air brake reservoir to approximately the same air pressure that is present in the tractor reservoirs.

(b) During normal operation of a tractor-trailer unit, the relay emergency valve serves as a relay valve and synchronizes trailer servicebrake air pressure and tractor service brake air pressure as the service foot brake valve on the tractor is operated. The trailer brakes can also be applied independently of the tractor brakes on some combinations by use of the hand control brake valve on the tractor and the relay emergency valve on the trailer.

(c) If a trailer is disconnected from a tractor for loading or unloading, or if the trailer is separated from the tractor under emergency breakaway conditions, or if its emergency line is vented to atmosphere by other means, the relay emergency valve applies the trailer brakes automatically at existing trailer reservoir pressure. If a trailer is to remain parked under these conditions, the wheels should be blocked to avoid the possibility of a runaway.

(d) If it is desired to release the emergency brake application on the trailer under these conditions, the trailer reservoir drain cock can be opened, or the trailer air brake system can be recharged through the trailer emergency line.

5. COMPONENT PARTS.

a. Illustrations.

(1) The parts depicted in the following illustrations are used primarily in emergency stopping systems.

(2) Parts which serve a dual function in the service and emergency brake systems may also be illustrated in Chapter 3 of this publication.

b. Spring Brake Actuator. Figure 4-8 shows a combination spring and service brake actuator.

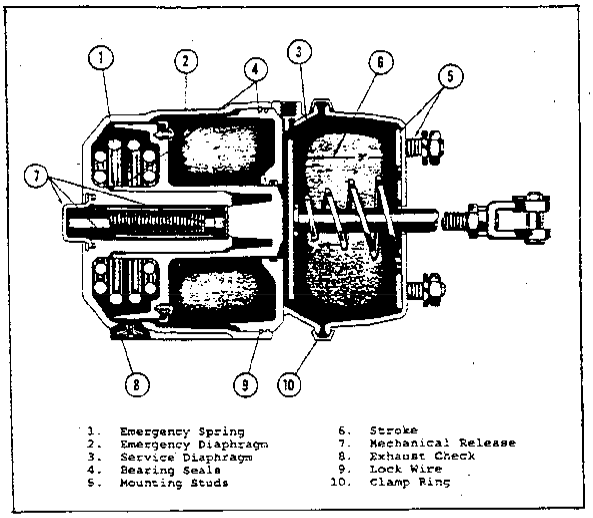

Fig. 4-8. Spring and Service Brake Actuator

(1) Description. This brake actuator will meet the requirement for service, emergency, and parking brakes when properly installed. It consists of a spring-applied emergency and/or parking brake and an air-applied service brake.

(2) Operation. Under normal operating conditions, the emergency spring is held in a compressed condition by air pressure applied against the emergency diaphragm. When the air is exhausted from the emergency section of the actuator, the spring will automatically apply the brake. The actuator may be installed to be manually and/or automatically applied under emergency conditions, or as a parking brake.

c. DD3 Brake Actuator. Figure 4-9 shows a DD3 brake actuator.

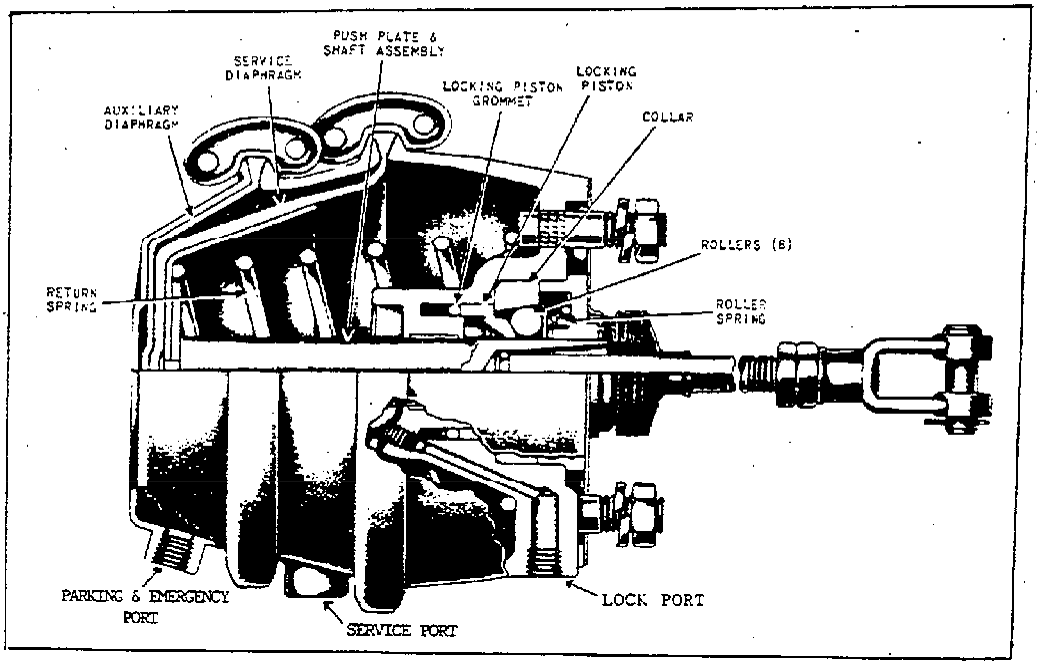

Fig. 4-9. DD3 Brake Actuator

(1) Description. The prefix "DD" indicates the Double Diaphragm and the suffix "3" denotes the triple action for service, parking, and emergency braking. The actuator functions normally as a service brake chamber but in addition has a means of mechanically locking a brake application so it can be used for parking. With various system arrangements, the actuator may be installed to be automatically or manually applied under emergency braking conditions.

(2) Operation. Through the operation of a control valve, air enters the actuator locking port and exerts pressure on the locking piston grommet. The resultant force moves the locking piston forward against the rollers and roller spring. The beveled or ramp end of the piston will pick up and hold the rollers away from the shaft.

(3) Normal Running. As long as air pressure remains against the locking piston and the rollers are not in contact with the shaft, normal service brake applications will permit the shaft to move freely, back and forth, past the locking mechanism. When a normal service brake application is made, air enters the actuator service port and pushes against the service diaphragm. The diaphragm moves the push plate and shaft out, applying the brakes. 'Upon release of the service application, the brakes are released.

(4) Parking. To park, air is exhausted from the locking port and air is applied against the auxiliary diaphragm through the parking and emergency port. When air is exhausted from the lock piston, the roller spring forces the rollers against the collar and shaft. Air entering the parking port exerts force on the auxiliary diaphragm. The diaphragm moves the push plate and shaft out, applying the brakes. With no air on the lock piston, if the shaft begins to retract, it becomes mechanically locked in the applied position when the rollers wedge between the shaft and collar.

NOTE: While in a parked position, when there is a loss of air pressure on the auxiliary diaphragm, the output force on the shaft is reduced. However, the shaft will not retract since its output force is transferred to the mechanical lock mechanism.

(5) Release of Parking Application.

(a) To release a parking application of the DD3 actuator, it is necessary to reapply air pressure to approximately equal the shaft force that was used in making the parking application. This-is necessary to release the locking rollers so they can be moved away from the shaft when air is reapplied to the locking piston. This can be accomplished by making a full service brake application after the control valve is operated to release the parking application.

NOTE: A full service brake application should never be made on a DD3 actuator when the control valve is in the "applied" or "park" position as this will compound the force on the shaft, locking it in the farthest extended position. When locked in this position, it is almost impossible to get the movement necessary to release the locking rollers.

(b) To release a parking application, air enters the locking piston and the air on the auxiliary diaphragm is exhausted. A full service brake application will be necessary to force the shaft forward sufficiently to allow the locking rollers to disengage and unlock the shaft. Upon release of the service application, the return spring will return the shaft to the release position, releasing the parking application.

(6) Emergency Operation. Through different system arrangements, the DD3 actuator, in conjunction with other automatic or manual air-applied valves, will operate for emergency situations in the same sequence as described under "Parking".

d. Inversion Valve, The inversion valve illustrated in figure 4-10a is the type used in conjuction with the DD3 brake chamber and the cab/driver compartment control valve for parking and/or emergency brakes. Figure 4-10b shows the Inversion valve in conjunction with the foot valve, control valve (Push-Pull) and DD3 Brake Chamber.

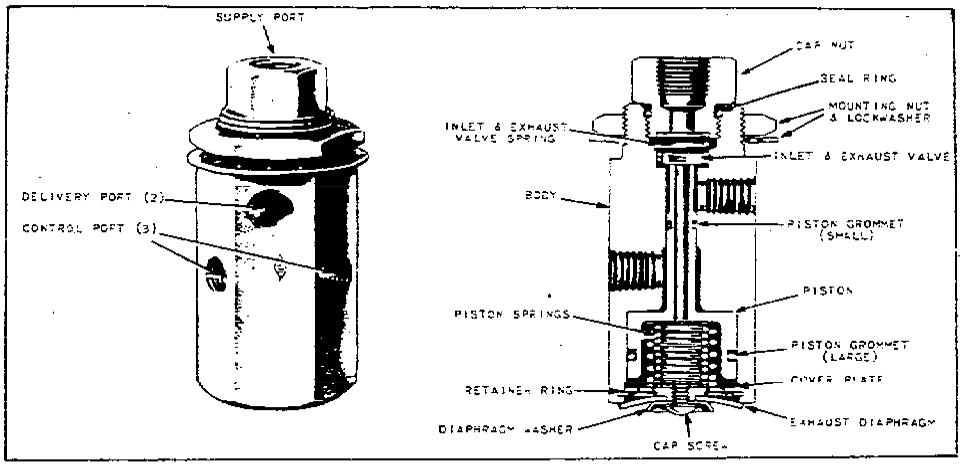

Figure 4-10a. Inversion valve

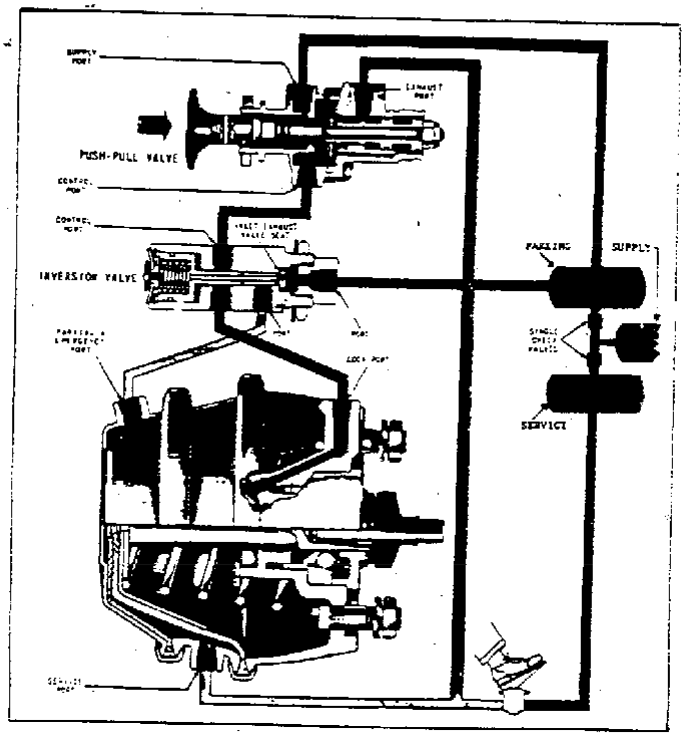

Figure 4-10b. Inversion Valve in conjunction with DD3 Actuator

(1) Description. The inversion valve is used in combination with the DD3 brake chambers and the control valve in a parking and/or emergency system. When the control valve is operated, the inversion valve operates, permitting air in the isolated reservoir to apply the brakes. The inversion valve also operates automatically when air pressure drops to a predetermined pressure.

(2) Operation. With no system air pressure, the inversion valve internal inlet valve is open and its exhaust valve is closed.

(a) On initial air build-up, air enters the isolated reservoir, which is also connected to the inversion valve supply port. Air passes through the valve, and out the delivery ports, to complete air build-up, prior to releasing the brakes.

(b) When system air pressure reaches between 50-60 psi, activating the, dash control valve applies system pressure to the inversion valve through one of the control ports.

(c) At a pressure between 60-70 psi, air pressure forces the piston down against spring resistance, seating the inlet valve, and exhausting any remaining air at the delivery port through the inversion valve exhaust port.

(d) Air in the isolated reservoir is now protected from the rest of the system by a check valve at one end, and the inversion valve at the other end.

(3) Parking or Emergency.

(a) When the dash control valve is operated (to apply the parking brakes), the air at the inversion valve control port,. which is holding the piston down against spring pressure, is exhausted through the dash control valve exhaust port.

(b) With the loss of air in the inversion valve, spring pressure forces the inversion valve piston upward, closing the exhaust passage and opening the inlet valve

(c) Air from the isolated reservoir passes by the open inlet valve and out the delivery ports to assist in applying the parking brakes.

(d) Activating the dash control valve to release the brakes reverses the above process, but may not necessarily release the brakes completely. A full service brake application after activating the dash control valve should complete the release. This applies more pressure than was utilized to set the parking brakes, and completely releases the mechanical device holding the parking brakes in place.

Note: Extreme caution must be used when conducting inspections on vehicles with DD3 brake chambers. If a full brake application is made (using the foot valve) at compressor cut-out, while the parking brakes are set, this will compound the air pressure utilized to set the parking brakes and make it extremely difficult to release the mechanical portion of the parking brake in the chamber.

e. DD2 Brake Actuator. Figure 4-11 shows a DD2 brake actuator.

(1) Description. The DD2 actuator is a double diaphragm actuator that functions normally as a service brake chamber, but in addition has an auxiliary diaphragm which is used for emergency braking. The actuator may be installed to be automatically or manually applied in various systems. Two (2) connecting lines are used for the actuator installations to the service and emergency ports.

(2) Normal Service Operation Application. On a normal service brake application, air enters through the service port on the pressure side of the actuator, forcing the diaphragm to move the push rod assembly forward. The push rod is connected to a slack adjuster which is attached to the cam shaft that rotates the brake cam and applies the brake shoes against the brake drums.

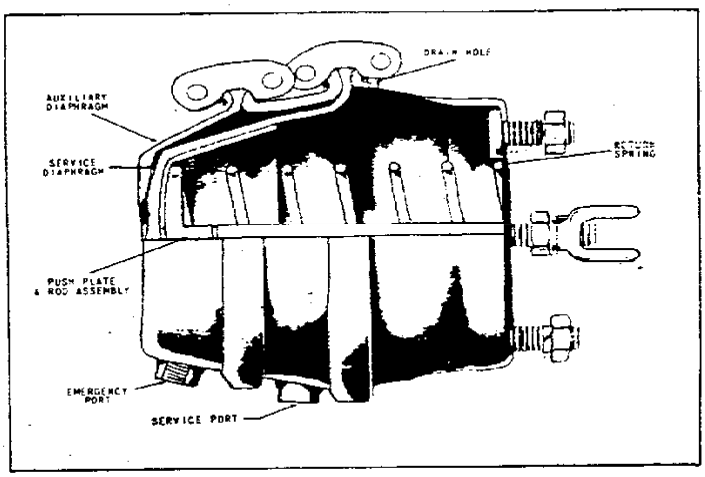

Fig. 4-11. DD2 Brake Actuator

(3) Emergency Application. Through different system arrangements, the DD2 actuator in conjunction with other automatic or manual applied air valves, will operate in emergency braking situations. During an emergency brake application, air enters the emergency diaphragm port on the pressure side of the actuator, forcing the emergency diaphragm and the service diaphragm forward to apply the vehicle brakes.

(4) Releasing. When air pressure is released from the actuator, the push rod return spring, in combination with the brake shoe return spring, returns the diaphragms, push rod, slack adjuster, and brake cam to their released. positions, releasing the brakes.

f. International Transquip Industries, Inc.(ITI) Brake Actuator.

Figure 4-12 shows an ITI Brake Actuator. Figure A shows the brake in an unapplied position and with the piston assembly pressurized and not mechanically locked. This represents normal vehicle operating condition. Figure B depicts a typical service-application. Figure C demonstrates an air application with the mechanical lock in place. This would occur after a park or during an emergency. Figure D shows such an application if air pressure continued to decrease.. Figure E is a more detailed view of the piston and pushrod.

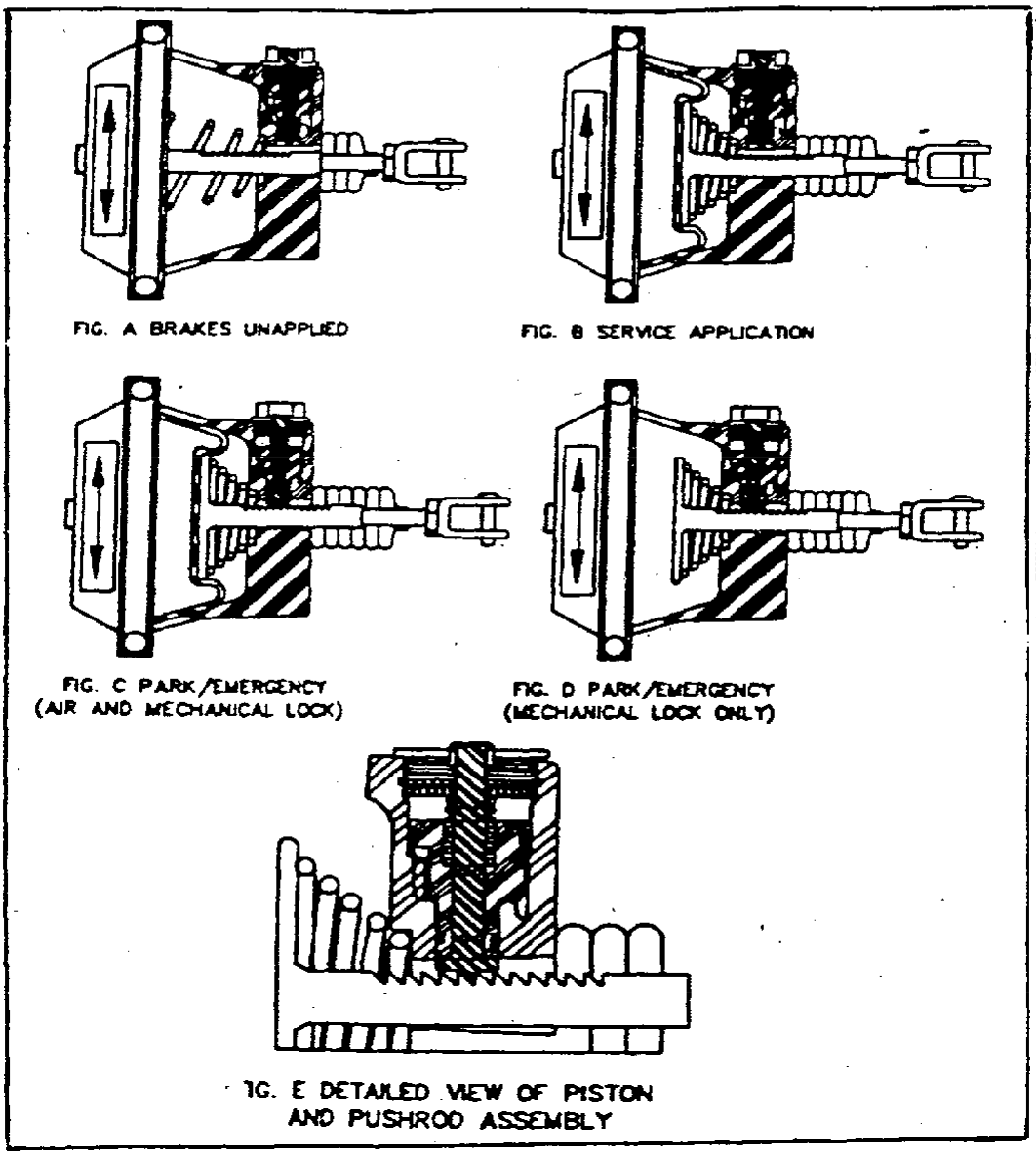

Figure 4-12. ITI Brake Actuator.

(1) Description. The ITI brake chamber is an air actuated, mechanically held parking, emergency, and service chamber for use on air braked vehicles. The brake chamber has a heavy duty rubber diaphragm which moves against a metal push plate and rod assembly under the influence of air pressure. The push rod, which has machined grooves or "teeth", is locked mechanically in place with a piston and pawl arrangement when air pressure is lost or exhausted from the piston chamber. The piston is powered by a controlling spring which will force the locking piston into the push rod in the absence of air pressure against the piston cylinder. The ITI Brake Actuator, illustrated in Figure 4-12, works as follows:

(2) Operation.

(a) Service Application. The ITI chamber performs service applications in the conventional manner. Air pressure is applied to the chamber diaphragm to make a brake application. Usually, this is accomplished through the use of a treadle valve signalling a service relay valve.

(b) Park Application. A park application is initiated by activating the park brake control or "push-pull" valve. This will exhaust supply air to the sensing valve in the ITI system and cause the brakes to apply. For those systems which use the ITI Control Valve (CV), air will then be exhausted from the piston chamber, which will cause the piston to engage the teeth in the push rod, locking the application in place. Locking of the push rod should occur after the brake application is made, thereby eliminating a cause of wear on the push rod rack and piston teeth. If a ratcheting sound occurs on a park application, this indicates an incorrect installation or malfunction and should be investigated.

(c) Emergency Application. ITI systems contain valves which sense a loss of air pressure. While ITI recommends the use of its proprietary CV, it is possible that under certain conditions, an alternative system configuration may be used. The most common valves which can be used, if installed within the proper system configuration, are relay emergency valves or inversion valves. All of these valves will automatically send an emergency air application to the brake chamber, applying the brakes in the event of a system loss of air pressure. The mechanical piston is spring-loaded and held.-released by primary and/or emergency tank air. If an emergency application is made due to a loss of this air pressure, the push rod will be locked in place by the mechanical piston.

NOTE: Some FMVSS 121 exempt systems employ a delayed mechanical park sequence. These systems contain a relay emergency valve in conjunction with an inversion load valve. In this configuration, the relay emergency valve initiates automatic application if supply (or trailer emergency) air is exhausted.. The piston chambers are plumbed from the emergency reservoir and will not engage unless emergency air pressure is lowered. A vehicle is therefore parked on air until or unless this tank loses air. !TI does, however, recommend the use of its proprietary CV.

6. PRELIMINARY INSPECTION PROCEDURES.

g. Safety Precautions. Block the wheels, leave the engine running, release all brakes, and instruct the driver to release or apply'brakes only as directed by brake inspector.

b Valve Position. On motor vehicles towing trailers, the tractor protection control valve should be in the normal position, the hand control valve should be off, and the cutoff cocks, if the vehicle is so equipped, should be open.

(1) If the dash control valve for the tractor protection valve is in the emergency position, or the cutoff cocks are off, no air is delivered to the towed vehicle and the towed vehicle brakes will not operate.

(2) If the hand valve is applied, the towed vehicle brakes will be applied and any movement of the brake chamber push rods will not represent the true state of brake adjustment when the foot valve is applied.

c. Depth of Inspections. Each inspection must be in sufficient detail to determine (as a minimum) the following:

(1) if the controls are marked as required on motor vehicles used to tow other vehicles.

(2) If the system functions as required.

(3) If the system is properly installed and maintained.

(4) If the driver is knowledgeable in its operation.

Note: Inspections should not proceed into an in-depth process for the purpose of maintenance inspections.

d. Adequacy of Emergency Stopping Systems. The only positive method of determining the adequacy of an emergency stopping system is by performance tests under actual operating conditions or by dynamometer testing.

e. Performance Requirements. Performance requirements for emergency stopping systems are contained in Vehicle Code Section 26508(k). References are included herein where appropriate for clarification of requirements or understanding of inspection procedures.

f. Service Brake Inspection.

(1) An inspection of the service brake system should be conducted prior to, or along with, the inspection of the emergency stopping system dependent on the type of emergency stopping system installed on the vehicle and the purpose of the inspection.

(2) A complete inspection of the service brake system is not necessary to determine if the emergency stopping system meets the requirements of the Vehicle Code.

7. INSPECTION PROCEDURE.

h. Basic Inspection. The basic inspection applies regardless of the type of emergency stopping system installed on the. vehicle. The remainder of the inspection depends upon the particular type of system to be inspected.

(1) Determine the type of emergency stopping system installed on the vehicle and whether the vehicle is used to tow other vehicles.

(2) Determine that the driver is familiar with the requirements of Section 26508 VC and that he or she is able to demonstrate the application and release of the emergency stopping system on each vehicle whether operated singly or in a combination of vehicles (Section 26508(o) VC).

(3) With the, air brake supply system at governor cutout pressure and the engine off, instruct the driver to apply, release, and reapply the emergency stopping system of the motor vehicle.

(a) Observe the movement of the slack adjusters and/or brake shoes to determine if the system is functioning properly.

(b) Observe whether the driver is able to apply and release the system from the driver's seat (Section 26508(b)(2), (f) VC).

(4) Determine that motor vehicles used to tow other -vehicles which use compressed air for applying the service brakes at the wheels are equipped with a manual and automatic means of applying the emergency stopping system on the towed vehicle(s), that the emergency position or method of operation of the manual device is clearly indicated, and that both devices function properly (Section 26508(b)(1) and (2), (f) VC).

(a) Regardless of the position of the manual control device, the automatic device must operate automatically when the service brake air supply of the towing vehicle is reduced to a level of not lower than 20 psi nor higher than 45 psi (Section 26508 (b)(1) VC).

1 The requirement is usually met by equipping the vehicle with a tractor protection valve.

2 The emergency stopping system on motor vehicles operated singly is not required to apply automatically but may be so designed.

(b) The requirement for manual operation is usually met by installing a dash-mounted control valve to permit manual operation of the tractor protection valve.

1 Toggle valves used for this purpose have the emergency position indicated with the word "emergency". The other position on the valve is usually labeled "normal" or "charged".

2 Push-pull type valves used for this purpose have such markings as "pull to apply." and "push to release".

3 No specific wording is required on valves used for this purpose but the emergency position or method of operation must be clearly indicated (Section 26508(b)(2) VC).

(c) The manual device must be operable by a person seated in the driver's seat.

(d) Vehicles which are not used to tow other vehicles are not required to be equipped with devices described in this paragraph.

(5) Determine whether the trailer brakes apply automatically when the service air is reduced to between 20 and 45 pounds per square inch when inspecting combinations of vehicles (Section 26508(b)(1) VC).

(6) Visually examine the system during the inspection process to determine if it is in good repair (Section 26453 VC).

(7) Observe the movement of the slack adjustors and/or brake shoes during application and release and determine if the brakes operate properly (Section 26453 VC).

(a) The application and release should be free of any binding or jerking movement.

(b) The shoes should set firmly against the drum when in the applied position.

(c) The shoes should not be in contact with the drum when in the released position.

(8) Determine that the emergency stopping systems on towed vehicles meet the following requirements:

(a) The air supply reservoir is protected against backflow through the supply line (Section 26508(d)(1) VC).

(b) The system applies automatically upon breakaway from the towing vehicle (Section 26508(d)(2) VC).

(c) The brakes remain applied for 15 minutes after breakaway (Section 26508(d)(2) VC).

i. Spring-Applied Systems on Motor Vehicles.

(1) Drain all air reservoirs used in the service brake system on the motor vehicle. This may be done by opening the petcock on the air tank or the air test kit when the kit is used. The treadle valve should not normally be used for this purpose.

(2) Instruct the driver to apply and release the spring brakes (Section 26508(o) VC).

(a) If the vehicle is equipped with an air starter, instruct the driver to start the engine before applying the brakes.

(b) The brakes must be capable of being applied and released by a person seated in the driver's seat, and

(c) The brakes must be capable of being released without any air remaining in the service brake system (Section 26508(f) VC).

1 Failure of the brakes to operate properly may be caused by any of the following conditions:

a No protected air reservoir.

b A defective check valve on the protected air reservoir.

c Improper operation of the cab controls.

d Improper plumbing.

2 There is no requirement for the spring to be completely compressed when the brakes are released.

(3) Instruct the driver to continue to apply and release the emergency system until the air pressure in the protected reservoir is too low to release the brakes.

(a) The brakes must remain in the applied position (Section 26508(f) VC).

(b) The brakes on motor vehicles which meet the requirements of Section 26508(c) VC (air applied systems) are not required to remain in the applied position provided:

1 All other requirements of Section 26508 VC are met, and

2 There is available a means which can be applied from the driver's seat to stop and hold the vehicle or combinations of vehicles. A lawful parking brake will usually meet this requirement.

(4) Ensure that all valves are returned to their proper position, all air lines are reconnected properly, all test equipment is removed, and that the driver builds the air pressure in the brake system up to governor cut-out before departing.

j. Axle-by-Axle Protected Air Brakes on Motor Vehicles.

(1) Check the system to determine that a separate air tank is provided for each axle (Section 26508(j) VC).

(a) Motor vehicles manufactured prior to 1964 are not required to have a separate air tank for each axle if a separate reservoir is provided for each of at least two axles and the system meets all other requirements of Section 26508 VC (Section 26508(c) VC).

(b) Motor vehicles manufactured after 1963, which are equipped with a dual treadle valve system, need have no more than two protected air

tanks in such system, one for each section of the dual treadle valve (Section 26508(j) VC).

(2) Open the drain cock(s) on the air reservoir(s) which supplies air to the service brake control valve. Do not drain the protected air reservoir(s).

(a) Do not use the treadle valve to deplete the air in the service brake system.

(b) On most of these systems, the treadle valve will exhaust the air from the service and emergency reservoirs simultaneously and cause the emergency system to apply automatically.

(3) Instruct the driver to apply and release the emergency stopping system (the brakes on at least one axle 'must apply). Determine that this can be done by a person seated in the driver's seat (Section 26508(f) VC).

(4) Have the driver continue to apply and release the emergency system until the air in the protected reservoir is too low to permit further operation of the system.

(a) Check to see that the brakes are applied.

(b) The emergency system shall not be capable of being released after a reapplication when the air pressure in the protected reservoir is reduced to a point where the emergency system could not be reapplied to stop and hold the vehicle unless the motor vehicle is manufactured prior to January 1, 1964, and the vehicle is equipped with a means to stop and hold the vehicle (Section 26508(c)(f) VC).

(5) Close the drain cock on the service air reservoir(s) and have the driver build the air pressure up to governor cut-out.

(6) With the engine stopped, drain the air from the protected reservoir(s).

(a) Now instruct the driver to apply the <u>service</u> brakes.

(b) There must be sufficient air remaining in the <u>service</u> system to stop the vehicle within the. limits specified in subsection (k) of Section 26508 VC. (See Section 26508(c) VC .f or exception for motor vehicles manufactured prior to 1964.) (Section 26508(e) VC).

(7) Close the drain cock on the protected air reservoir, remove all test equipment, and instruct the driver to build up the air pressure to governor cut-out before departing.

k. Dual Circuit Systems on Motor Vehicles.

(1) Determine the particular type of system installed on the vehicle, how it should function, how it is plumbed, and which air reservoir(s) is/are used for the emergency stopping system.

(2) Most dual circuit systems use a dual treadle valve, two air reservoirs, and are usually plumbed as described in (a) or (b) below.

(a) Each air tank is piped to a separate stage of the treadle valve; one tank is used to supply the service brake system and the other tank is used to supply the emergency stopping system. The emergency air reservoir is protected against backflow by a check valve and is plumbed to the lower stage of the treadle valve and to a dash-mounted control valve.

Full application of the treadle valve or operation of the dash-mounted control valve will activate the emergency stopping system. An illustration of a system of this type is provided in Fig. 4-4. In the illustration, a dual-compartment air tank is used as a wet tank for the service brake system and a protected tank for the emergency stopping system.

(b) Each air tank is piped to a separate stage of the dual treadle valve and the secondary emergency circuit is also piped to a dash-mounted control valve. Air to operate the service brakes (primary circuit) is drawn from both air tanks simultaneously under normal operating conditions. Both air tanks are protected against backflow by check valves and both are equipped with pressure protection valves to prevent either tank from exhausting through the other as a result of a failure in the system. This system is used primarily on Ford trucks and is illustrated in Fig. 4-6.

(3) If the system is plumbed as described in paragraph (2)(a) above, drain the air reservoir used to supply the service brakes and proceed as prescribed in paragraphs (5), (6), (7), and (8).,

(4) If the system is plumbed as described in paragraph (2)(b), drain the air reservoir used to supply the primary circuit and proceed with the check as prescribed in paragraphs (6) and (7).

(a) Follow the procedure specified in paragraphs (7) and (8) to complete the inspection.

(b) The primary circuit is considered to be the service brake system and the secondary circuit is considered to be the emergency stopping system for inspection purposes.

(c) Do not deplete the reservoir air pressure by repeated application of the treadle valve as this will exhaust both reservoir tanks simultaneously.

(5) Instruct the driver to apply the emergency system.

(a) The emergency system must operate without any air remaining in the service system (Section 26508(f) VC)..

(b) The treadle valve may not be used to apply the emergency system (Section 26508(e) VC).

(c) The emergency system must be operable by a person seated in the driver's seat.

(6) Instruct the driver to continue to apply and release the emergency system until the air pressure in the protected reservoir is too low to further release the brakes. The brakes must remain in the applied position (Section 26508(f) VC).

(7) Close the drain on the service air reservoir and instruct the driver to build the air pressure up to governor cut-out. Then stop the engine and drain the air from the reservoir' for the emergency system.

(a) Instruct the driver to apply the service brakes.

(b) There must be sufficient air remaining in the service system to stop the vehicle within the limits specified in subsection (k) of Section 26508 VC. (See Section 26508(c) VC for exception for motor vehicles manufactured prior to 1964.) (Section 26508(e) VC)

(8) Close the drain cock on the protected reservoir, remove all test equipment, and instruct the driver to build the air pressure to governor cut-out before departure.

l. Mechanical Systems.

(1) Instruct the driver to apply and release the brake.

(a) The mechanical brake must be operable without assistance from the service brake system (Section 26508(f) VC).

(b) It must be applied and released by a person seated in the driver's seat (Section 26508(f) VC).

(c) It must be adequate to enable the vehicle or combination of vehicles to meet the requirements of subsection (k) of Section 26508 VC.

(2) If the vehicle is used to tow other vehicles which use compressed air for applying the service brakes at the wheels, it must also be equipped with a manual or automatic means of applying the emergency stopping system on the towed vehicle, usually a tractor protection valve with a dash-mounted control.

(3) The emergency system shall not be capable of being released after any reapplication when the handbrake is air assisted from a protected reservoir, and the air pressure is reduced to the point where the emergency system cannot be reapplied to stop and hold the vehicle (Section 26508(f) VC).

m. Relay Emergency Valve Air-Applied System on Trailers.

(1) Reduce the air in the service brake system on the motor vehicle until the trailer brakes apply automatically.

(a) Trailer brakes must apply automatically when the air pressure in the service brake system on the towing vehicle is reduced to a pressure not lower than 20 psi nor higher than 45 psi (Section 26508(b)(1) VC).

(b) A tractor protection valve that fails to vent the emergency line will prevent automatic application of the trailer brakes.

(2) Disconnect both air lines between the vehicles at the gladhands, and check the air reservoir on the trailer for protection against backflow by placing a thumb over the ends of the open air lines on the trailer (Section 26508(d)(1) and (2) VC).

(a) The brakes must apply automatically upon breakaway, and

(b) They must remain applied for at least 15 minutes (Section 26508(d)(2) VC).

(3) A simple check of the RE valve can be made by disconnecting the trailer supply line (emergency line) at the gladhands.

(a) The trailer brakes should apply automatically.

(b) There should be no backflow of air from the trailer through the open line.

(4) Observe the position of the slack adjusters and brake shoes to ensure that the brakes are fully applied.

(5) There is no specific requirement that the emergency stopping system on towed vehicles can be capable of being released after being applied. However, subsection (h) of Section 26508 VC does prohibit any system that creates a hazard on the highway.

(a) Relay emergency valve systems can be released by draining the air tank on the trailer. The wheels of the trailer should be blocked before the tank is drained to avoid a runaway vehicle.

(b) Some spring brake actuators are designed with an internal manual release feature which makes it possible to manually release the brakes after the air pressure is exhausted from the device.

(6) Under most conditions, it is expected that inspection of emergency stopping systems on towed vehicles will be conducted in conjunction with inspection of the service brake system and emergency stopping system on the motor vehicle.

THIS PAGE INTENTIONALLY LEFT BLANK