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ABSTRACT

This correspondence course, orginally developed for the Marine Corps, is designed to provide mechanics with an understanding of the basic operations of automotive brake systems on military vehicles. The course contains four study units covering hydraulic brakes, air brakes, power brakes, and auxiliary brake systems. A troubleshooting guide for hydraulic and air brake systems along with a guide to bleeding hydraulic brake systems are included as appendixes. Each study unit begins with a general objective, which is a statement of what the student should learn from the study unit. The study units are divided into numbered work units, each presenting one or more specific objectives, and illustrated unit texts. At the end of the unit texts are study questions with answers. A review lesson completes the course. (KC)

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MARINE CORPS INSTITUTE, MARINE BARRACKS
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35.15a

1. ORIGIN

MCI course 35.15a, Automotive Brake Systems, has been prepared by the Marine Corps Institute.

2. APPLICABILITY

This course is for instructional purposes only.

J. M. D. HOLLADAY
Lieutenant Colonel, U. S. Marine Corps
Deputy Director

ACKNOWLEGEMENT

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INFORMATION

FOR

MCI STUDENTS

Welcome to the Marine Corps Institute training program. Your interest in self-improvement and increased professional competence is commendable.

Information is provided below to assist you in completing the course. Please read this guidance before proceeding with your studies.

1. MATERIALS

Check your course materials. You should have all the materials listed in the "Course Introduction." In addition you should have an envelope to mail your review lesson back to MCI for grading unless your review lesson answer sheet is of the self-mailing type. If your answer sheet is the pre-printed type, check to see that your name, rank, and social security number are correct. Check closely, your MCI records are kept on a computer and any discrepancy in the above information may cause your subsequent activity to go unrecorded. You may correct the information directly on the answer sheet. If you did not receive all your materials, notify your training NCO. If you are not attached to a Marine Corps unit, request them through the Hotline (autovon 288-4175 or commercial 202-433-4175).

2. LESSON SUBMISSION

The self-graded exercises contained in your course are not to be returned to MCI. Only the completed review lesson answer sheet should be mailed to MCI. The answer sheet is to be completed and mailed only after you have finished all of the study units in the course booklet. The review lesson has been designed to prepare you for the final examination.

It is important that you provide the required information at the bottom of your review lesson answer sheet if it does not have your name and address printed on it. In courses in which the work is submitted on blank paper or printed forms, identify each sheet in the following manner:

DOE, John J. Sgt 332-11-9999
08.4g, Forward Observation
Review Lesson
Military or office address
(RUC number, if available)

Submit your review lesson on the answer sheet and/or forms provided. Complete all blocks and follow the directions on the answer sheet for mailing. Otherwise, your answer sheet may be delayed or lost. If you have to interrupt your studies for any reason and find that you cannot complete your course in one year, you may request a single six month extension by contacting your training NCO, at least one month prior to your course completion deadline date. If you are not attached to a Marine Corps unit you may make this request by letter. Your commanding officer is notified monthly of your status through the monthly Unit Activity Report. In the event of difficulty, contact your training NCO or MCI immediately.

3. MAIL-TIME DELAY

Presented below are the mail-time delays that you may experience between the mailing of your review lesson and its return to you.

	TURNAROUND MAIL TIME	MCI PROCESSING TIME	TOTAL NUMBER DAYS
EAST COAST	16	5	21
WEST COAST	16	5	21
FPO NEW YORK	18	5	23
FPO SAN FRANCISCO	22	5	27

You may also experience a short delay in receiving your final examination due to administrative screening required at MCI.

4. GRADING SYSTEM

LESSONS			EXAMS	
GRADE	PERCENT	MEANING	GRADE	PERCENT
A	94-100	EXCELLENT	A	94-100
B	86-93	ABOVE AVERAGE	B	86-93
C	78-85	AVERAGE	C	78-85
D	70-77	BELOW AVERAGE	D	65-77
NL	BELOW 70	FAILING	F	BELOW 65

You will receive a percentage grade for your review lesson and for the final examination. A review lesson which receives a score below 70 is given a grade of NL (no lesson). It must be resubmitted and PASSED before you will receive an examination. The grade attained on the final exam is your course grade, unless you fail your first exam. Those who fail their first exam will be sent an alternate exam in which the highest grade possible is 65%. Failure of the alternate will result in failure of the course.

5. FINAL EXAMINATION

ACTIVE DUTY PERSONNEL: When you pass your REVIEW LESSON, your examination will be mailed automatically to your commanding officer. The administration of MCI final examinations must be supervised by a commissioned or warrant officer or a staff NCO.

OTHER PERSONNEL: Your examination may be administered and supervised by your supervisor.

6. COMPLETION CERTIFICATE

The completion certificate will be mailed to your commanding officer and your official records will be updated automatically. For non Marines, your completion certificate is mailed to your supervisor.

7. RESERVE RETIREMENT CREDITS

Reserve retirement credits are awarded to inactive duty personnel only. Credits awarded for each course are listed in the "Course Introduction." Credits are only awarded upon successful completion of the course. Reserve retirement credits are not awarded for MCI study performed during drill periods if credits are also awarded for drill attendance.

8. DISENROLLMENT

Only your commanding officer can request your disenrollment from an MCI course. However, an automatic disenrollment occurs if the course is not completed (including the final exam) by the time you reach the CCD (course completion deadline) or the ACCD (adjusted course completion deadline) date. This action will adversely affect the unit's completion rate.

9. ASSISTANCE

Consult your training NCO if you have questions concerning course content. Should he/she be unable to assist you, MCI is ready to help you whenever you need it. Please use the Student Course Content Assistance Request Form (ISO-1) attached to the end of your course booklet or call one of the AUTOVON telephone numbers listed below for the appropriate course writer section.

PERSONNEL/ADMINISTRATION	288-3259
COMMUNICATIONS/ELECTRONICS/AVIATION	
NBC/INTELLIGENCE	288-3604
INFANTRY	288-3611
ENGINEER/MOTOR TRANSPORT	288-2275
SUPPLY/FOOD SERVICES/FISCAL	288-2285
TANKS/ARTILLERY/INFANTRY WEAPONS REPAIR	
LOGISTICS/EMBARKATION/MAINTENANCE MANAGEMENT/	
ASSAULT AMPHIBIAN VEHICLES	288-2290

For administrative problems use the UAR or call the MCI HOTLINE: 288-4175.

For commercial phone lines, use area code 202 and prefix 433 instead of 288.

HOW TO TAKE THIS COURSE

This course contains 4 study units. Each study unit begins with a general objective that is a statement of what you should learn from the study unit. The study units are divided into numbered work units, each presenting one or more specific objectives. Read the objective(s) and then the work unit text. At the end of the work unit are study questions that you should be able to answer without referring to the text of the work unit. After answering the questions, check your answers against the correct ones listed at the end of the study unit. If you miss any of the questions, you should restudy the text of the work unit until you understand the correct responses. When you have mastered one study unit, move on to the next. After you have completed all study units, complete the review lesson and take it to your training officer or NCO for mailing to MCI. MCI will mail the final examination to your training officer or NCO when you pass the review lesson.

AUTOMOTIVE BRAKE SYSTEMS

Course Introduction

AUTOMOTIVE BRAKE SYSTEMS is designed to introduce the Automotive Mechanic to the basic operations of automotive brake systems incorporated on military vehicles. A troubleshooting guide for hydraulic and air brake systems along with a guide to bleeding hydraulic brake systems are included as appendices so the mechanic may keep a ready reference to troubleshooting brake systems in his tool box. Maintenance and repair information including removal of components, is covered in the technical manual concerning the respective vehicle and therefore, not covered in this course.

ADMINISTRATVIE INFORMATION

ORDER OF STUDIES

Study Unit Number	Study Hours	Subject Matter
1	2	Hydraulic Brakes
2	2	Air Brake System
3	2	Power Brakes
4	1	Auxiliary Brake Systems
	2	REVIEW LESSON
	2	FINAL EXAMINATION
	11	

RESERVE RETIREMENT CREDITS: 5

EXAMINATION: Supervised final examination without text or notes with a time limit of 2 hours.

MATERIALS: Review lesson and answer sheet. MCI 35.15a, Automotive Brake Systems.

RETURN OF MATERIALS: Students who successfully complete this course are permitted to keep the course materials.

Students disenrolled for inactivity or at the request of their commanding officers will return all course materials.

SOURCE MATERIALS

TM 9-8000	Principles of Automotive Vehicles	Jan 56
TM 9-2320-206-20	Truck-Tractor 10 tons 6 X 6 M123	Oct 71
TM 9-2320-209-20	Truck Cargo 2-1/2 ton 6 X 6 M-35	Apr 65
TM 9-2320-218-20	Truck Utility 1/4 ton 4 X 4 M151	Sept 71
TM 9-2320-260-20	Truck 5 ton 6 X 6 M809	Jul 72
TM 9-2320-266-20	Truck Cargo 1-1/4 ton 4 X 4 M880	Jan 76
TM 9-2320-272-20-1	Truck Chassis 5 ton 6 X 6 M939	Sept 82
TM 9-2320-272-20-2	Truck Chassis 5 ton 6 X 6 M939	Oct 82
TM 9-2320-272-34-2	Truck Chassis 5 ton 6 X 6 M939 (DS&GS)	Oct 82
TM 9-2320-289-20	Truck Cargo 1 1/4 ton 4 X 4 M1008	Apr 83
TM 9-2320-289-34	Truck Cargo 1 1/4 ton 4 X 4 M1008	May 83

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MARINE CORPS INSTITUTE

STUDY GUIDE

Welcome to the Marine Corps Institute correspondence training program. By enrolling in this course, you have shown a desire to improve the skills you need for effective job performance, and MCI has provided materials to help you achieve your goal. Now all you need is to develop your own method for using these materials to best advantage.

The following guidelines present a four-part approach to completing your MCI course successfully:

1. Make a "reconnaissance" of your materials;
2. Plan your study time and choose a good study environment;
3. Study thoroughly and systematically
4. Prepare for the final exam.

I. MAKE A "RECONNAISSANCE" OF YOUR MATERIALS

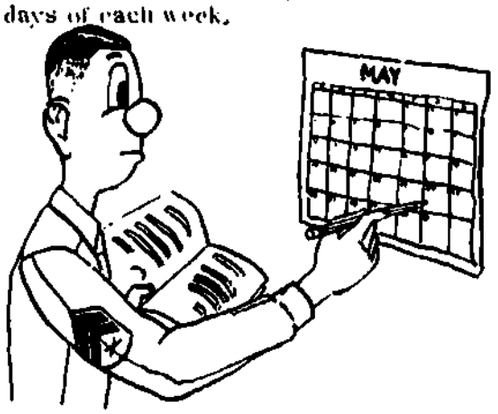
Begin with a look at the course introduction page. Read the COURSE INTRODUCTION to get the "big picture" of the course. Then read the MATERIALS section near the bottom of the page to find out which text(s) and study aids you should have received with the course. If any of the listed materials are missing, see Information for MCI Students to find out how to get them. If you have everything that is listed, you are ready to "reconnoiter" your MCI course.

Read through the table(s) of contents of your text(s). Note the various subjects covered in the course and the order in which they are taught. Leaf through the text(s) and look at the illustrations. Read a few work unit questions to get an idea of the types that are asked. If MCI provides other study aids, such as a slide rule or a plotting board, familiarize yourself with them. Now, get down to specifics!

II. PLAN YOUR STUDY TIME AND CHOOSE A GOOD STUDY ENVIRONMENT

From looking over the course materials, you should have some idea of how much study you will need to complete this course. But "some idea" is not enough. You need to work up a personal study plan: the following steps should give you some help.

(A) Get a calendar and mark those days of the week when you have time free for study. Two study periods per week, each lasting 1 to 3 hours, are suggested for completing the minimum two study units required each month by MCI. Of course, work and other schedules are not the same for everyone. The important thing is that you schedule a regular time for study on the same days of each week.



(B) Read the course introduction page again. The section marked ORDER OF STUDIES tells you the number of study units in the course and the approximate number of study hours you will need to complete each study unit. Plug these study hours into your schedule. For example, if you set aside two 2-hour study periods each week and the ORDER OF STUDIES estimates 2 study hours for your first study unit, you could easily schedule and complete the first study unit in one study period. On your calendar you would mark "Study Unit 1" on the

appropriate day. Suppose that the second study unit of your course requires 3 study hours. In that case, you would divide the study unit in half and work on each half during a separate study period. You would mark your calendar accordingly. Indicate on your calendar exactly when you plan to work on each study unit for the entire course. Do not forget to schedule one or two study periods to prepare for the final exam.

(C) Stick to your schedule.

Besides planning your study time, you should also choose a study environment that is right for you. Most people need a quiet place for study, like a library or a reading lounge; other people study better where there is background music; still others prefer to study out-of-doors. You must choose your study environment carefully so that it fits your individual needs.

III. STUDY THOROUGHLY AND SYSTEMATICALLY

Armed with a workable schedule and situated in a good study environment you are now ready to attack your course study unit by study unit. To begin, turn to the first page of study unit 1. On this page you will find the study unit objective, a statement of what you should be able to do after completing the study unit.

DO NOT begin by reading the work unit questions and flipping through the text for answers. If you do so, you will prepare to fail, not pass, the final exam. Instead, proceed as follows:

(A) Read the objective for the first work unit and then read the work unit text carefully. Make notes on the ideas you feel are important.

(B) Without referring to the text, answer the questions at the end of the work unit.

(C) Check your answers against the correct ones listed at the end of the study unit.

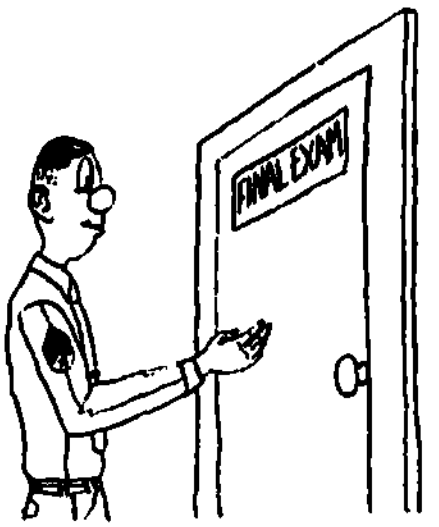
(D) If you miss any of the questions, restudy the work unit until you understand the correct response.

(E) Go on to the next work unit and repeat steps (A) through (D) until you have completed all the work units in the study unit.

Follow the same procedure for each study unit of the course. If you have problems with the text or work unit questions that you cannot solve on your own, ask your section OIC or NCOIC for help. If he cannot aid you, request assistance from MCI on the Student Course Content Assistance Request included with this course.

When you have finished all the study units, complete the course review lesson. Try to answer each question without the aid of reference materials. However, if you do not know an answer, look it up. When you have finished the lesson, take it to your training officer or NCO for mailing to MCI. MCI will grade it and send you a feedback sheet listing course references for any questions that you miss.

IV. PREPARE FOR THE FINAL EXAM



How do you prepare for the final exam? Follow these four steps:

(A) Review each study unit objective as a summary of what was taught in the course.

(B) Reread all portions of the text that you found particularly difficult.

(C) Review all the work unit questions, paying special attention to those you missed the first time around.

(D) Study the course review lesson, paying particular attention to the questions you missed.

If you follow these simple steps, you should do well on the final. GOOD LUCK!

STUDY UNIT 1

HYDRAULIC BRAKES

STUDY UNIT OBJECTIVE: WITHOUT THE AID OF REFERENCES, YOU WILL IDENTIFY THE PURPOSE AND CONSTRUCTION OF THE HYDRAULIC BRAKE SYSTEM, ITS COMPONENTS AND THEIR FUNCTION.

Work Unit 1-1. INTRODUCTION

STATE HOW THE BRAKE SYSTEM IS DESIGNED TO RETARD THE MOTION OF A VEHICLE.

STATE THE CAUSE OF FRICTION.

STATE THE TYPE OF SURFACES IN THE BRAKE SYSTEM.

STATE WHAT IS REQUIRED OF BRAKES IN ORDER FOR THEM TO BE EFFECTIVE.

LIST THE FIVE ADVANTAGES OF A HYDRAULIC BRAKE SYSTEM.

DEFINE PASCAL'S LAW OF HYDRAULIC LIQUIDS.

DESCRIBE HOW FORCE IN HYDRAULICS IS MULTIPLIED.

The automotive brake system is a friction device that changes power into heat. When the brake is applied, it converts the rolling momentum of the vehicle (kinetic energy) into heat (friction). In the brake system, friction is caused by a rotating surface (brake drum) in contact with a non-rotating surface (brake shoes). When the brakes are applied, the surfaces come together and friction heat is created.

For brakes to be efficient, a great amount of force is needed to stop a moving vehicle. Therefore, a requirement of brakes is that your vehicle must be able to decelerate faster than it can accelerate. For example, a vehicle with a 100-horsepower engine requires approximately 50 seconds to accelerate to 50 miles per hour. However, the same vehicle is expected to be able to stop when traveling at 50 mph in not more than 5 seconds. In other word, the brakes must do the same amount of work as the engine in one tenth the amount of time. This means the brakes must develop above 1000 horsepower to stop the vehicle.

When brakes are applied, the brake shoes are forced into contact with the brake drums which slow or stop the rotation of the wheel. Then friction between the tires and the road surface slows the vehicle.

An understanding of hydraulics is important to the mechanic. The following is a list of five advantages that hydraulic brakes have over mechanical brakes.

a. Rods, gears, and levers are eliminated.

b. Motion and pressure can be transmitted equally throughout the system.

c. The hydraulic system requires no lubrication.

d. Liquids are not subjected to wear or breakage as are mechanical parts.

e. Force can be greatly multiplied.

Now let's discuss the physical properties of liquids. A liquid differs greatly from a solid in that a liquid does not have a form of its own; it conforms to the shape of the container in which it is held. Because of this shapelessness, movement of liquids can be accomplished in tubing, by gravity, or by applying force.

Under normal conditions liquids can not be compressed. It would take a tremendous amount of force to compress a liquid to one tenth of its volume. According to Pascal's Law, any force applied to a confined liquid is transmitted equally in all directions and the shape of the container makes no difference. Study fig 1-1 and fig 1-2 following:

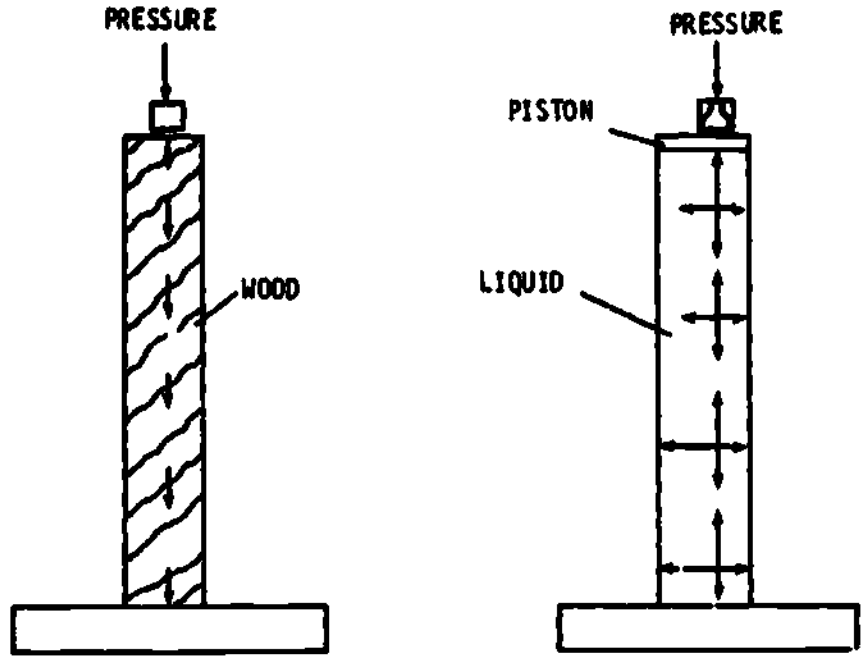


Fig 1-1. Stress on liquid as compared with wood.

Note: Arrows illustrate the action of force between a block of wood and confined liquid.

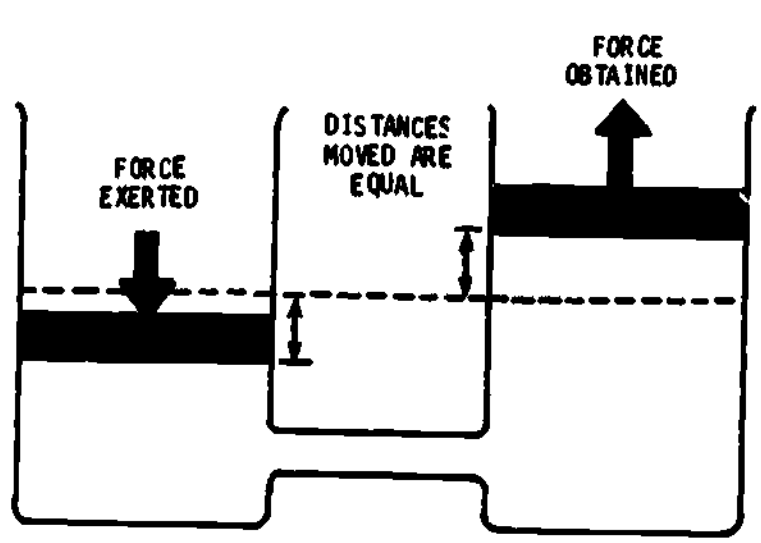


Fig 1-2. Distribution of forces in hydraulic system using same size piston.

In fig 1-2, the pistons in both containers are the same size; therefore, the input and output forces and the pressure in each container are equal.

Forces are also multiplied proportionally by the size of the pistons. For example, in fig 1-3, the input piston is 10 times the area of the output piston. The force is multiplied by 10 but the output piston travel is decreased to one tenth the input piston travel.

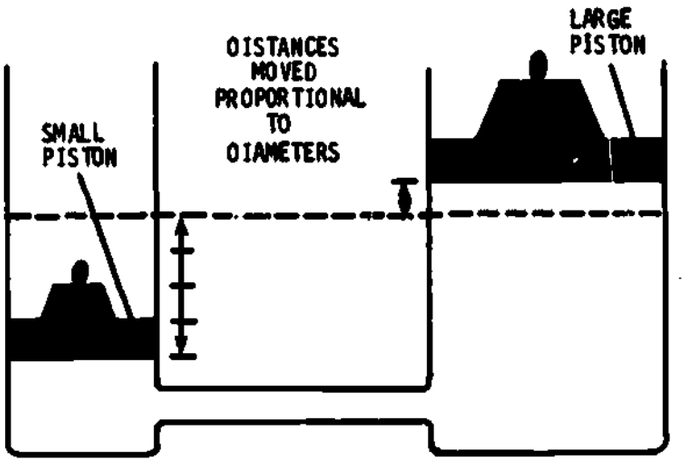


Fig 1-3. Distribution of forces using different size pistons.

By applying these principles to hydraulic brakes, a heavy truck can be stopped with little force applied to the brake pedal.

In the hydraulic brake system the liquid used must meet various requirements. There are five requirements that hydraulic brake fluid must possess:

a. It must not corrode metal nor deteriorate rubber components.

b. It must have a high boiling point.

c. It must have a low freezing point.

d. It must be self lubricating.

e. It must evaporate slowly.

For the hydraulic brake system to provide positive braking action under all conditions, hydraulic fluid must meet all of the five requirements above.

EXERCISE: Answer the following questions and check your responses against those listed at the end of this study unit.

1. State the means a brake system uses to retard the motion of a vehicle.

_____

2. State the cause of friction.

_____

_____

3. State the type of surfaces in the brake system (in relation to movement).

_____

4. State what is required of brakes in order for them to be effective.

_____

_____

5. List the five advantages of the hydraulic brake system.

   a. _____

   b. _____

   c. _____

   d. _____

   e. _____

6. Define Pascal's Law of hydraulic liquids.

_____

_____

7. Describe how force in hydraulics is multiplied.

_____

_____

8. What are the five requirements of hydraulic brake fluid?

   a. _____

   b. _____

   c. _____

   d. _____

   e. _____

Work Unit 1-2. HYDRAULIC BRAKE MASTER CYLINDER

STATE THE PURPOSE OF THE MASTER CYLINDER.

STATE THE PURPOSE OF THE CHECK VALVE IN THE MASTER CYLINDER.

LIST THE TWO TYPES OF METALS USED IN THE CONSTRUCTION OF MASTER CYLINDERS.

STATE THE PURPOSE OF THE DUAL MASTER CYLINDER.

In the introduction to brakes, you found that liquids are virtually noncompressible and that pressure exerted on a liquid will remain the same throughout the system. This principle is applied to operate the hydraulic brakes on most vehicles. In fig 1-4 a foot pedal is attached to a master cylinder. As the pedal is depressed, a piston moves in the master cylinder, forcing hydraulic fluid throughout the system including the wheel cylinders. This causes the pistons in the wheel cylinders to move the brake shoes out against the brake drum causing friction which retards the movement of the vehicle.

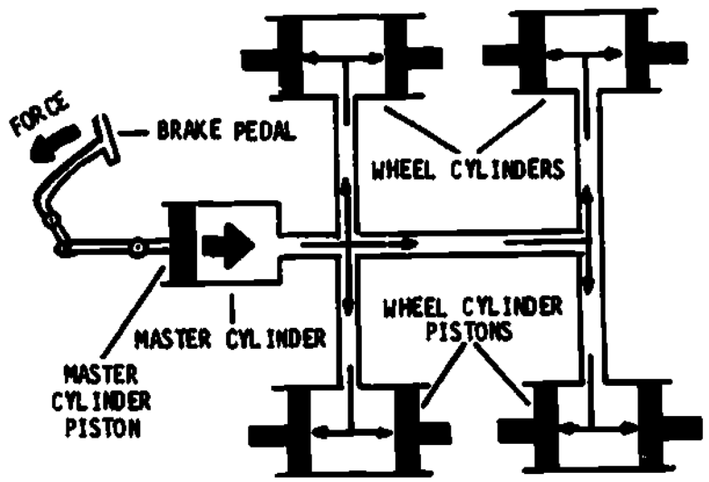


Fig 1-4. Basic hydraulic brakes.

The brake pedal can be mounted two ways: either suspended from a bracket or pivoted below the floorboard. A rod connects the pedal to the master cylinder, establishing brake pedal free travel. This free travel ensures that the brakes are fully released.

The master cylinder (fig 1-5) changes mechanical force to hydraulic pressure; it is essentially a pump that forces hydraulic brake fluid throughout the brake system. Master cylinders may be made of aluminum or cast iron.

Incorporated within the cylinder, is a reservoir which stores an adequate supply of brake fluid. The reservoir is vented through the filler cap. The two ports allow fluid from the reservoir to enter the cylinder.

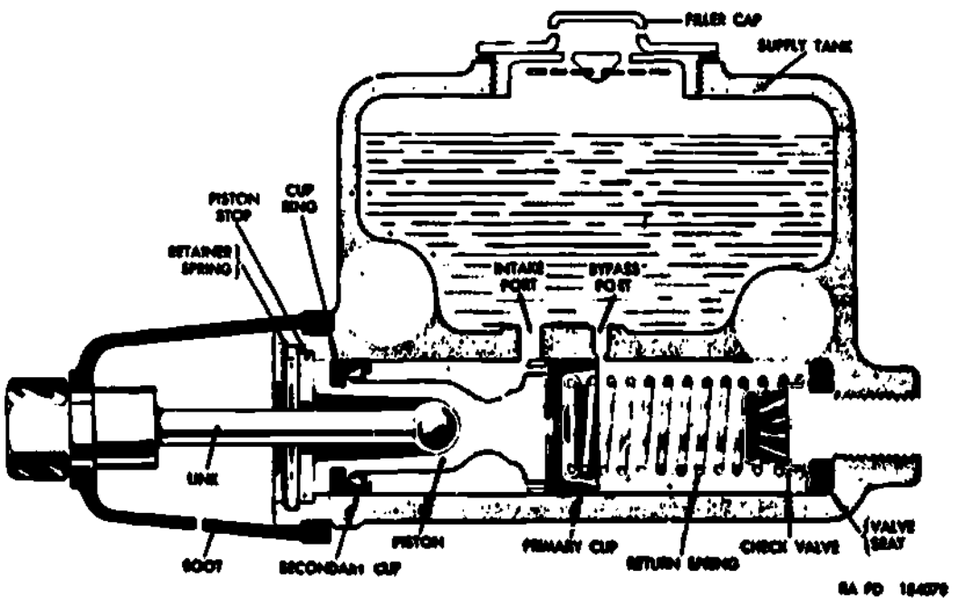


Fig 1-5. Master cylinder.

The piston, which is a spool-like device, has a rubber secondary cup sealing the open end of the cylinder. If this cup does not seal properly, brake fluid will appear around the boot. The piston supports the rubber primary cup which forces brake fluid through a check valve and then throughout the hydraulic system. A return spring keeps the cup in place. The check valve is also held in place by the return spring. The valve rests on a rubber washer that seals the system. The check valve and spring maintain residual pressure in the hydraulic brake lines preventing air from entering the system. A steel disk and retainer keep the working parts in the cylinder. However, not all master cylinders have a check valve.

As the brake pedal is depressed, the linkage moves through the piston retainer and causes the primary cup to close the bypass port, creating hydraulic pressure. Brake fluid under pressure passes through the check valve into the lines and hoses and finally into the wheel cylinders where the pistons, in turn, push the brake shoes against the brake drum, thereby slowing or stopping the vehicle. When the pedal is released, the hydraulic pressure in the system unseats the check valve to allow fluid back into the reservoir. The brake shoe's return spring retracts the brake shoes, pushing the wheel cylinder piston to the released position.

As the retracting spring pressure from the brake shoe dissipates, the return spring in the master cylinder seats the check valve to hold static (residual) pressure in the system.

The dual master cylinder (fig 1-6), also known as the split system or tandem master cylinder, is designed to separate the front from the rear brake systems. Should one system fail, the other will make it possible to stop the vehicle. The dual master cylinder has two separate reservoirs, a primary piston and a secondary piston. The basic principle of operation is the same as the single piston master cylinder, except for the double reservoir, tandem pistons, two compensating ports and no check valve in disc brake circuit.

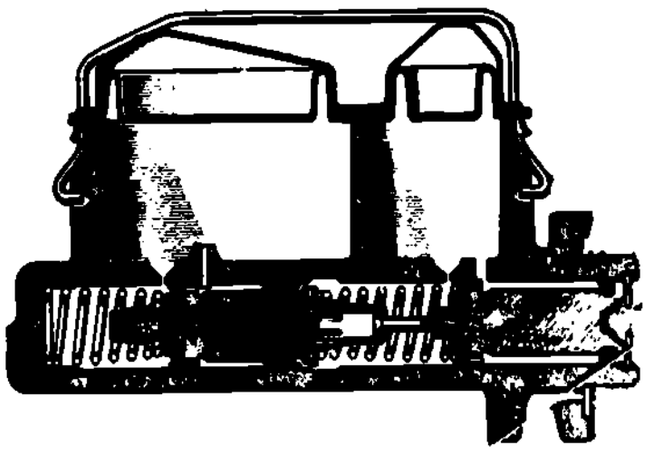


Fig 1-6. Dual master cylinder.

EXERCISE: Answer the following questions and check your responses against those listed at the end of this study unit.

1. State the purpose of the master cylinder.

_____

2. State the purpose of the check valve in the master cylinder.

_____

3. List the two metals used in the construction of master cylinders.

   a. _____

   b. _____

4. What is the purpose of the dual master cylinder?

_____

_____

Work Unit 1-3. DRUM BRAKES

STATE THE TYPE OF METAL USED IN THE CONSTRUCTION OF BRAKE LINES.

STATE THE PURPOSE OF THE WHEEL CYLINDER.

DESCRIBE WHAT HAS TO BE DONE WHEN AIR HAS ENTERED THE HYDRAULIC BRAKE SYSTEM.

STATE WHICH BRAKE SHOE FACES TOWARD THE FRONT OF THE VEHICLE.

NAME THE TWO WAYS THAT BRAKE LINING IS MOUNTED ON THE BRAKE SHOES.

STATE THE PREFERRED TYPE OF BRAKE DRUM THAT IS USED TODAY.

STATE THE ACTION THAT INCREASES BRAKING FORCE.

The master cylinder which created hydraulic pressure, forces hydraulic brake fluid through steel brake lines (fig 1-7) to the wheel cylinders. These brake lines are constructed of high quality, double thick steel tubing. The tubing is copperplated and lead-coated to prevent rust and corrosion. Never replace a brake line with copper or inferior steel tubing. It is essential that a vehicle's brake lines be constructed of high quality steel. The brake line must be secured to prevent vibration which causes metal fatigue and brake line failure. At each front wheel cylinder or caliper, a high pressure hose carries fluid. A high pressure hose is also used at the rear axle due to the movement of the suspension.

The purpose of the wheel cylinder is to change hydraulic pressure created by the master cylinder to mechanical force thereby forcing the brake shoes outward towards the drum.

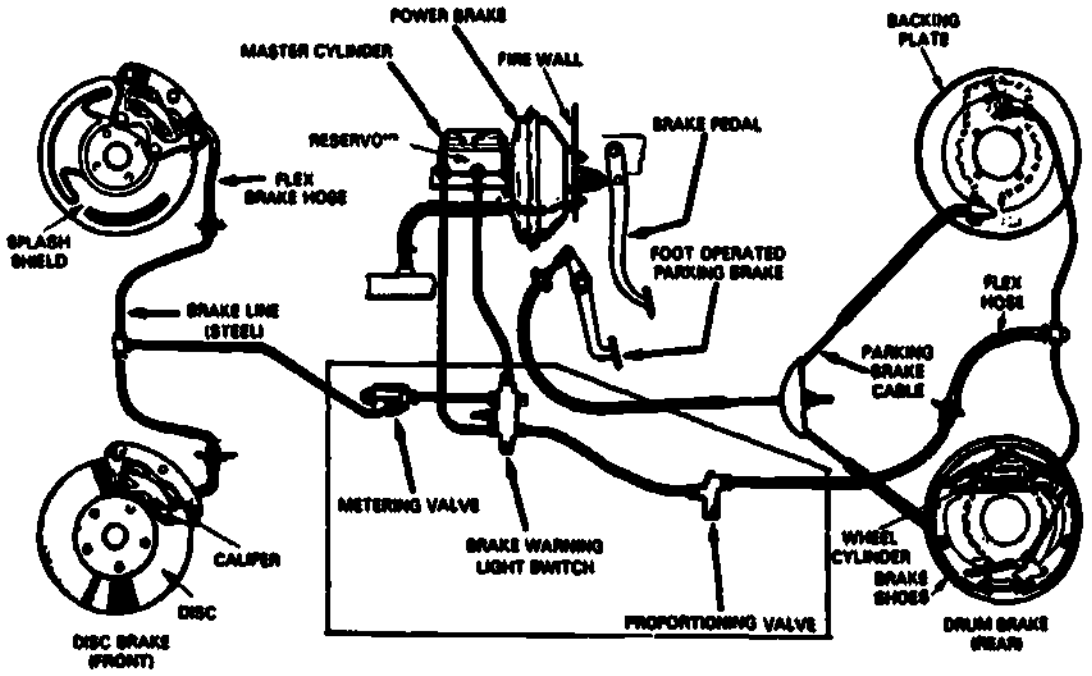


Fig 1-7. Typical brake system.

The wheel cylinder (fig 1-8) consists of a cast iron housing, two aluminum or iron pistons, two rubber cups, a coil spring, two push rods, and two dust covers. There are also two drilled and tapped holes in the body of the wheel cylinder. The upper hole is used to bleed air out of the system. The other hole is used to connect the brake line.

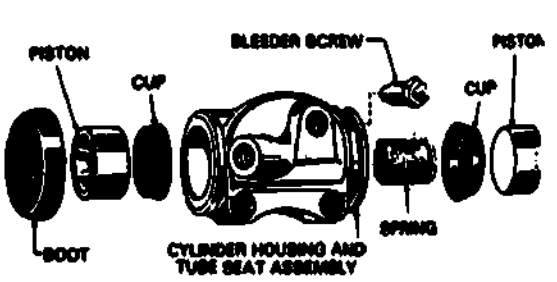


Fig 1-8. Typical wheel cylinder.

As the master cylinder forces brake fluid through the lines into the wheel cylinder, the pressurized fluid pushes the two pistons outward, which causes the brake shoes to contact the brake drum.

The hydraulic brake system must be free of air. Since air is highly compressible, if it is present within the hydraulic system. It will cause a spongy brake pedal, and, therefore, less effective brakes. Air can be removed from the system by using the procedures in Appendix III.

The wheel cylinder is bolted to a backing plate, a round steel plate bolted or riveted at each end of the axle housing. This is the foundation for the wheel cylinder and brake shoes. On the front of the vehicle the backing plate is bolted or made integral with the steering knuckle or spindle. Brake shoes are categorized as a primary brake shoe, which is the front or lead shoe, and a secondary shoe, the trail or reverse shoe (fig 1-9). Since most of the braking action is created by the primary shoe it has less lining or lining of a different material than the secondary shoe. Due to the tendency of the brake shoes to rotate with the drum, less friction is needed on the front (primary) shoe to wedge the secondary or rear shoe between the anchor pin and brake drum. The wedging of the secondary (rear) shoe does most of the braking.

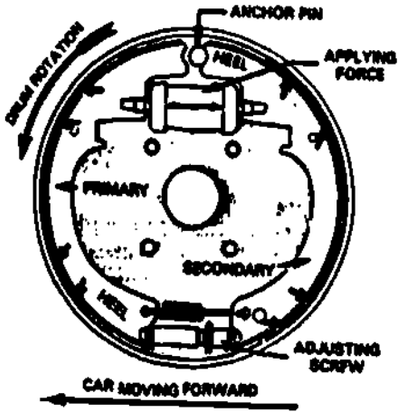


Fig 1-9. Brake assemoly.

The shoes are made of pressed steel while the lining materials are made of asbestos interwoven with a soft metal such as copper or brass to provide longer wear. Heavy duty lining materials are of a special metallic nature which are very resistant to brake fading on heavy trucks. The linings are either riveted or bonded (glued) to brake shoes.

The brake drum is bolted between the wheel and hub. The brake drum completely surrounds the brake assembly. Brake drums can be constructed of pressed steel for strength or cast iron to dissipate heat quickly or a combination of both. The type of brake drum preferred is called a centrifuse brake drum which is a pressed center with a cast iron liner (fig 1-10). On heavy duty trucks, brake drums are made of cast iron which is heavy, but dissipate heat quickly. The braking area of the drum must be smooth, round, and parallel to the shoes.

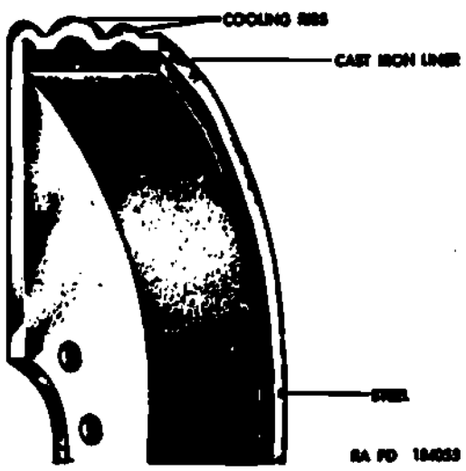


Fig 1-10. Centrifuse brake drum.

Now let's study the action of the brake shoes. As noted in fig 1-11, the primary shoe has a tendency to rotate with the drum which produces some braking action. When both shoes are mounted without being anchored to the backing plate, both shoes will rotate with the drum thereby increasing the braking force. This servo action wedges the secondary shoe between the wheel cylinder or anchor pin and the brake drum. Servo action or self-energized brakes increase the braking force with a slight increase of pressure on the brake pedal.

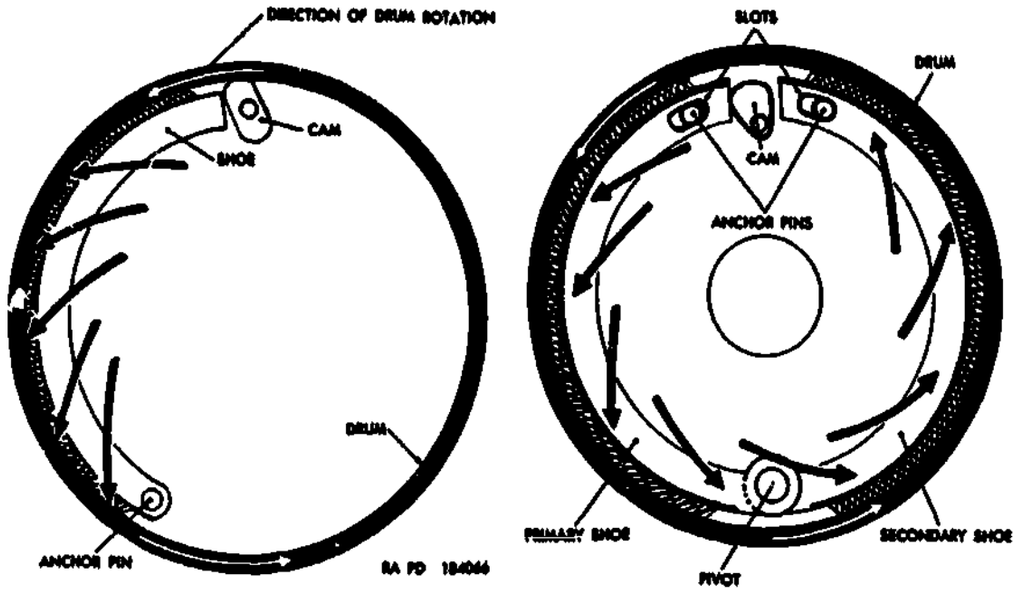


Fig 1-11. Self-energization or servo action.

EXERCISE: Answer the following questions and check your responses against those listed at the end of this study unit.

1. State the type of metal used in the construction of brake lines.

_____

2. State the purpose of the wheel cylinder.

_____

3. Describe what has to be done when air has entered the hydraulic brake system.

_____

_____

4. State which brake shoe faces towards the front of the vehicle.

_____

5. Name the two ways that brake lining is mounted on the brake shoes.

a. _____

b. _____

6. State the preferred type of brake drums that are used today.

_____

7. What action is used to increase braking force?

_____

Work Unit 1-4. DISC BRAKES

STATE THE PURPOSE OF THE METERING VALVE IN THE DISC BRAKE SYSTEM.

STATE THE PURPOSE OF THE PROPORTIONING VALVE.

NAME THE COMPONENT IN THE CALIPER THAT PULLS THE PISTON AWAY FROM THE DISC OR ROTOR WHEN THE BRAKES ARE RELEASED.

In the previous work unit you learned about drum brakes. Now let's discuss a slightly different type of wheel brake--the disc brake. Disc brakes are normally used on the front wheels of vehicles while drum brakes are used on the rear wheels. The main difference between the two is the use of a clamping action rather than an expanding shoe assembly.

The disc brake uses a heavy disc or rotor instead of a drum, with a caliper and brake pads to provide the clamping action. The rotor is bolted to the hub on the front wheel of the vehicle. Calipers will have one or two pistons. The hydraulic disc brake system uses a metering valve and proportioning valve which are not required with drum brakes.

The metering valve insures that the rear drum brake engages at about the same time as the front brake pads engage the disc so the front and rear brakes do about the same amount of work. The metering valve prevents fluid movement to the front disc brake until a buildup of pressure in the rear brake overcomes the brake shoe's retracting spring pressure and the shoes contact the drum. Then the metering valve allows brake fluid to move to the front caliper. Due to the pad and to rotor clearance of 0.005 inch or less there are no retracting or return springs. Study fig 1-7 for the location of the metering valve.

A proportioning valve can also be found in the disc brake system. The purpose of this valve is to prevent rear wheel lockup during rapid stops. This valve limits the amount of pressure to the rear wheels which is directly proportional to the amount of pressure developed within the master cylinder. A restrictive or small orifice is used to proportion the pressure. Disc brakes are more efficient than drum brakes in that the exposed disc cools very rapidly. Due to the size of friction pads a greater amount of pressure is needed to equalize the braking effort; however, greater pressure can be created with the clamping action of the calipers.

The M880 and M1008 (CUCV) incorporate a combination valve (fig 1-12), which combines the metering valve, proportioning valve and a brake failure switch in one unit. The location of this valve is indicated by the blocked area of figure 1-7. The function of each section in the combination valve is identical to the individual units. The brake failure switch activates a warning light on the instrument panel to warn the operators of a difference in pressure between the front and rear hydraulic systems of the dual master cylinder.

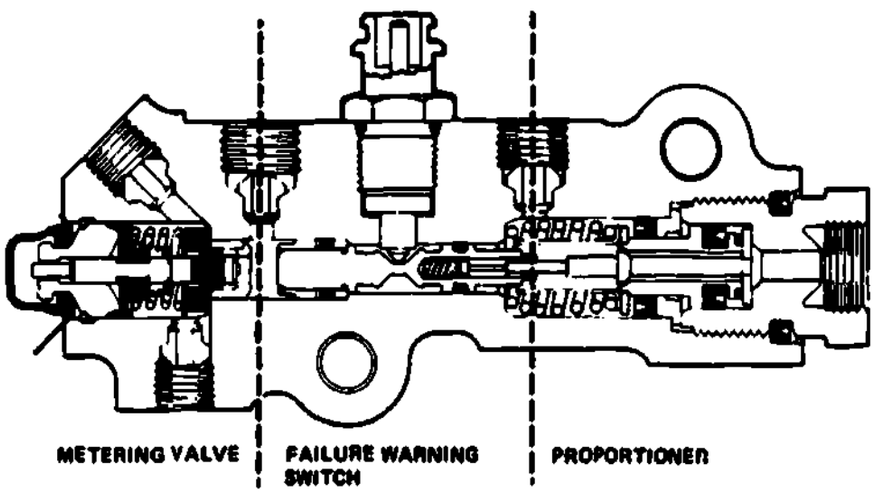


Fig 1-12. Combination valve.

Now, we'll discuss the calipers and how they function.

The caliper is mounted to the front spindle. The caliper piston pushes self-centering friction pads under pressure which clamp to the rotor or disc provide braking effort.

The calipers are either of one or two piston types. Caliper pistons are constructed of cast iron, aluminum, or plastic and are fitted in the caliper cylinder with the outer end resting against the inside pad. A rubber boot prevents dirt and water from entering.

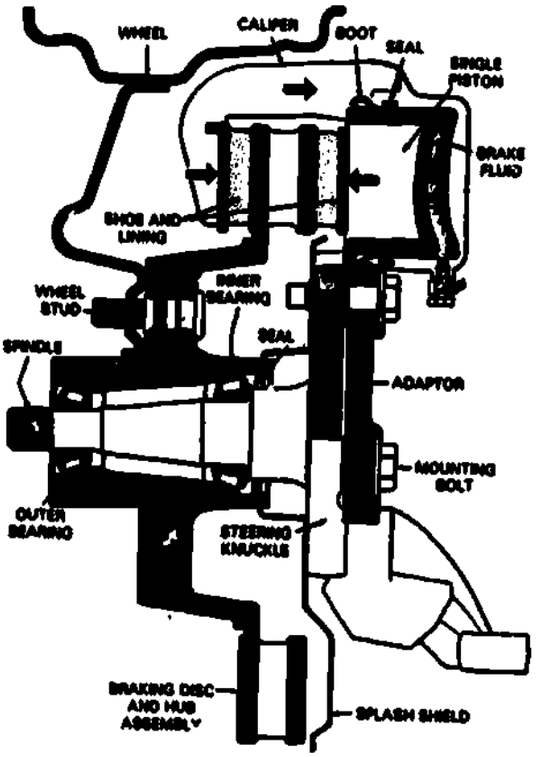


Fig 1-13. Caliper action.

Hydraulic pressure from the master cylinder moves the piston towards the rotor and the caliper in the opposite direction which clamps the pads on each side of the rotor equally. A seal is snapped in a groove in the caliper cylinder (fig 1-14). When the piston is moved the seal stretches. Then, when the brakes are released, the seal will roll back into a neutral or normal position pulling the caliper and piston with it.

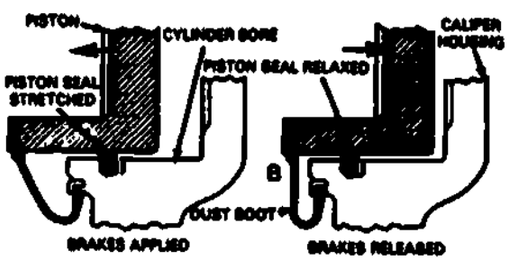


Fig 1-14. Caliper return action.

EXERCISE: Answer the following questions and check your responses against those listed at the end of this study unit.

1. State the purpose of the metering valve in the disc brake system.

_____

_____

2. State the purpose of the proportioning valve.

_____

_____

3. Name the component in the caliper that pulls the piston away from the disc or rotor when the brakes are released.

_____

SUMMARY REVIEW

In this study unit, you have learned about the hydraulic brake system, its components, and their functions. For a troubleshooting guide on hydraulic brake systems use Appendix 1 or the appropriate technical manual concerning the vehicle. In the next study unit, you will be introduced to air brakes.

Answers to Study Unit #1 Exercises

Work Unit 1-1.

1. Friction
2. Friction is caused by a rotating surface coming into contact with a non-rotating surface.
3. Non-rotating and rotating
4. They must be able to decelerate faster than they can accelerate.
5. a. Rods, gears, and levers are eliminated
   b. Motion and pressure can be transmitted equally
   c. No lubrication required
   d. Force can be greatly multiplied
   e. Liquids are not subjected to wear or breakage
6. Any force applied to a confined liquid is transmitted equally in all directions throughout the liquid.
7. If the input piston is smaller than the output piston, force is increased
8. a. Does not corrode or deteriorate metal or rubber
   b. High boiling point
   c. Low freezing point
   d. Self lubricating
   e. Slow evaporation

Work Unit 1-2.

1. To change mechanical force to hydraulic pressure
2. To maintain residual pressure in the brake system so air will not enter
3. a. Aluminum
   b. Cast iron
4. To separate the front and rear brake systems which allow the vehicle to be stopped

Work Unit 1-3.

1. High quality, double thickness. steel tubing
2. To change hydraulic pressure to mechanical force
3. The hydraulic brake system must be bled.
4. Primary brake shoe
5. a. Riveted to the brake shoes
   b. Bonded to the brake shoes
6. Centrifuse
7. Self-energizing action

Work Unit 1-4.

1. It ensures that the rear drum brake is applied at about the same time as the front disc brake and they both do the same amount of work.
2. To prevent the rear wheels from locking during rapid stops
3. Caliper seal

STUDY UNIT 2

AIR BRAKE SYSTEM

STUDY UNIT OBJECTIVE: WITHOUT THE AID OF REFERENCES, YOU WILL IDENTIFY THE PROPERTY OF COMPRESSED AIR USED IN THE AIR BRAKE SYSTEM. YOU WILL ALSO IDENTIFY THE RESULTING FORCE OBTAINED BY A BRAKE CHAMBER. LASTLY, YOU WILL IDENTIFY THE FUNCTION OF EACH COMPONENT WITHIN THE AIR BRAKE SYSTEM AND HOW IT OPERATES.

Work Unit 2-1. INTRODUCTION

NAME THE PROPERTY COMPRESSED AIR HAS WHEN USED IN AN AIR BRAKE SYSTEM.

WHEN GIVEN THE AIR PRESSURE ADMITTED TO A CYLINDER AND THE AREA OF THE PISTON, IDENTIFY BY COMPUTATION, THE RESULTING FORCE OBTAINED BY THE BRAKE CHAMBER.

Air has many uses when applied to the automotive field. It is used when spraying paint, inflating tires, and blowing foreign matter from parts. All of the heavy motor transport vehicles use compressed air in the application of brakes and other equipment.

Compressed air is any amount of normal air confined to a smaller space (reservoir) which increases the pressure exerted on the internal surfaces of the container. For instance, normal air has an atmospheric pressure of 14.7 pounds per square inch (psi). This is the air everyone breathes. Now take 10 gallons of air (normal pressure) and confine it to one tenth the space (one gallon) in an air tight container. The air is now compressed and the pressure in the container has increased to about 10 times the original pressure. When suitable piping is provided, compressed air reacts in much the same manner as a liquid. For example, air will move from a reservoir under pressure to another one which has less pressure. This movement will continue until the pressure is equal in both reservoirs.

The application of air in the operation of brakes is fairly simple. In fig 2-1 compressed air enters a cylinder which has a piston connected to a lever. The pressure of the compressed air will act on the piston which will move to equalize the pressure of the air with the force on the lever. This force can be determined by multiplying the air pressure admitted to the cylinder times the area of the piston.

Example: Use the formula $F = AP$

where F = force in pounds per square inch

A = area of piston (or diaphragm)

P = air pressure admitted to the cylinder

If the area of the piston is 50 square inches and the air pressure admitted is 20 psi then: $F = 50 \times 20 = 1000$ pounds of force

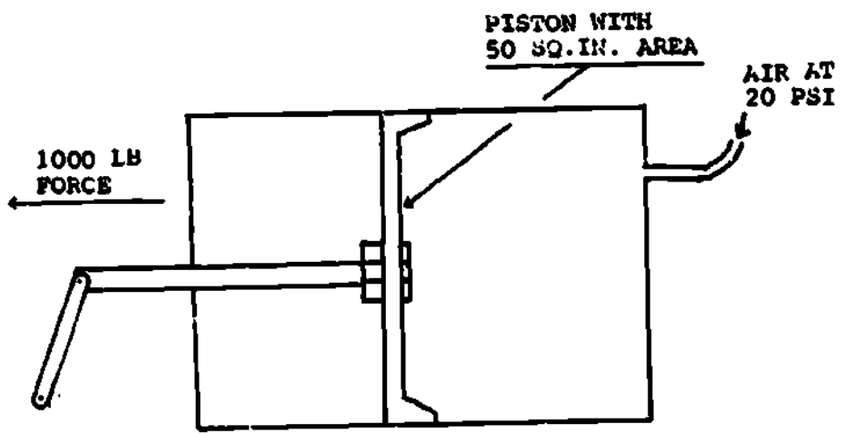


Fig 2-1. Principle of a simple air brake.

As you can see with the compressed air system, much greater braking force may be

utilized as compared to hydraulic system, however, we must have an air compressing system on the vehicles. Remember, that the pressure of air entering the cylinder (chamber) and the area of the piston (diaphragm) in the cylinder affect the force obtained. For a troubleshooting guide, refer to Appendix II or the technical manual of the respective vehicle for assistance.

EXERCISE: Answer the following questions and check your responses against those listed at the end of this study unit.

1. The property of compressed air as used in an air brake system is _____

_____.

2. Identify the resulting force of a brake chamber with a diaphragm (piston) area of 50 square inches (8 inches in diameter) and 25 PSI applied to the chamber.

   a. 100 lbs
   b. 1000 lbs
   c. 1250 lbs
   d. 1550 lbs

Work Unit 2-2. AIR SUPPLY SYSTEM

STATE THE FUNCTION OF EACH COMPONENT WITHIN THE AIR SUPPLY SYSTEM.

IDENTIFY WHY THE PRESSURE GAGE AND WARNING BUZZER MUST BE OPERATIONAL AT ALL TIMES.

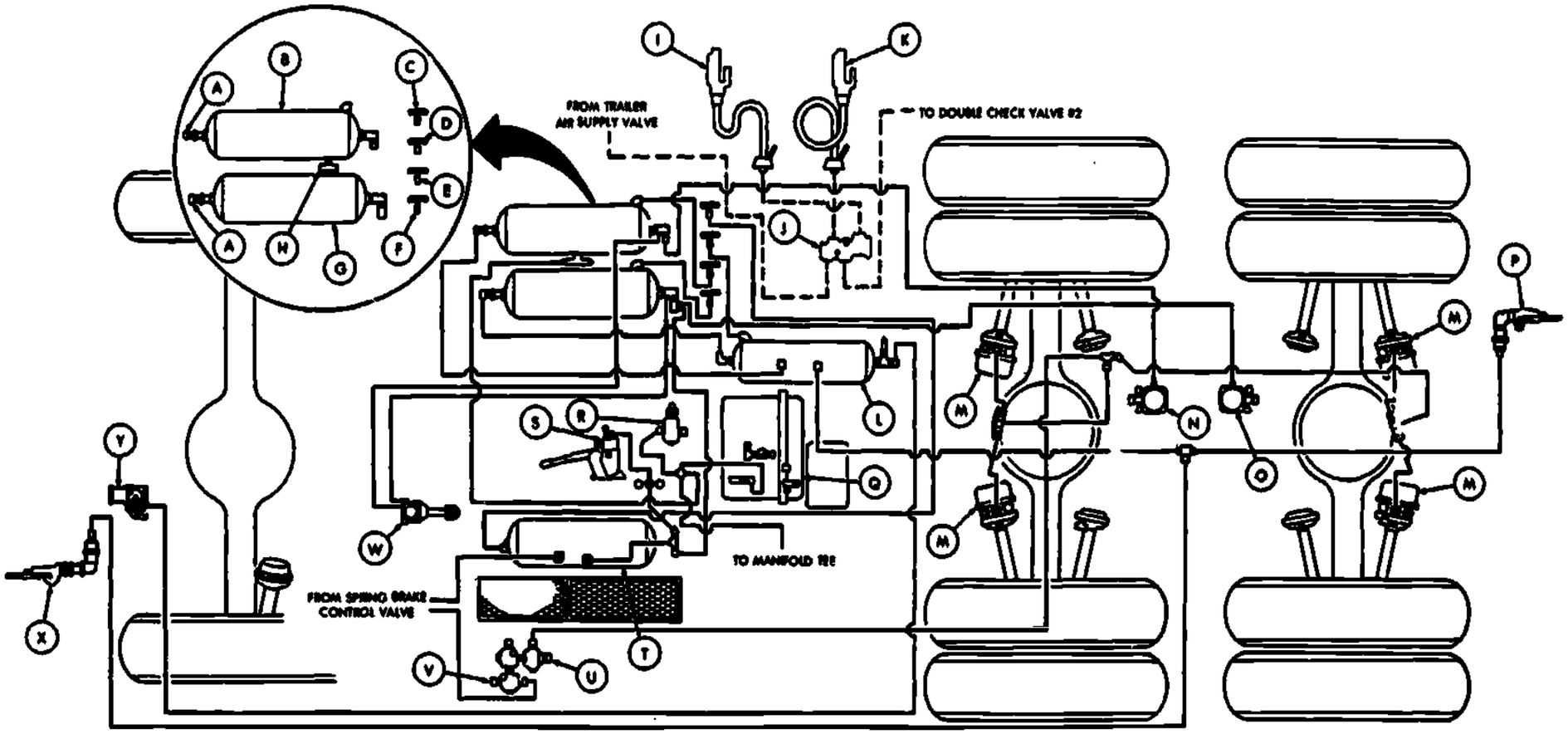
Air brake equipment on heavy vehicles provides a means of controlling the vehicle speed through the use of compressed air. This is accomplished by a group of devices illustrated in fig 2-2. The following discussion will cover the air supply components only. Control devices will be discussed in a later work unit. For maintenance and adjustment of the components refer to the TM of the respective vehicle.

ALL MODEL VEHICLES

LEGEND:

ALL MODELS

M931, M932 ONLY



(A) ONE-WAY CHECK VALVE
(B) SECONDARY AIR RESERVOIR
(C) SPRING BRAKE RESERVOIR DRAINCOCK
(D) WET RESERVOIR DRAINCOCK
(E) SECONDARY RESERVOIR DRAINCOCK
(F) PRIMARY RESERVOIR DRAINCOCK
(G) PRIMARY AIR RESERVOIR
(H) PRESSURE PROTECTION VALVE
(I) SERVICE TRAILER COUPLING (M931, M932 ONLY)
(J) TRAILER PROTECTION VALVE (M931, M932 ONLY)
(K) EMERGENCY TRAILER COUPLING (M931, M932 ONLY)
(L) WET SUPPLY RESERVOIR
(M) COMBINATION SPRING AND SERVICE BRAKE CHAMBER
(N) SECONDARY RELAY VALVE
(O) PRIMARY RELAY VALVE
(P) REAR EMERGENCY AIR COUPLING
(Q) TRANSFER CASE
(R) TRANSFER CASE ACTUATOR VALVE
(S) PARKING BRAKE VALVE
(T) SPRING BRAKE AIR RESERVOIR
(U) QUICK-RELEASE VALVE
(V) DOUBLECHECK VALVE #4
(W) BRAKE PEDAL (TREADLE) VALVE
(X) FRONT EMERGENCY AIR COUPLING
(Y) AIR COMPRESSOR

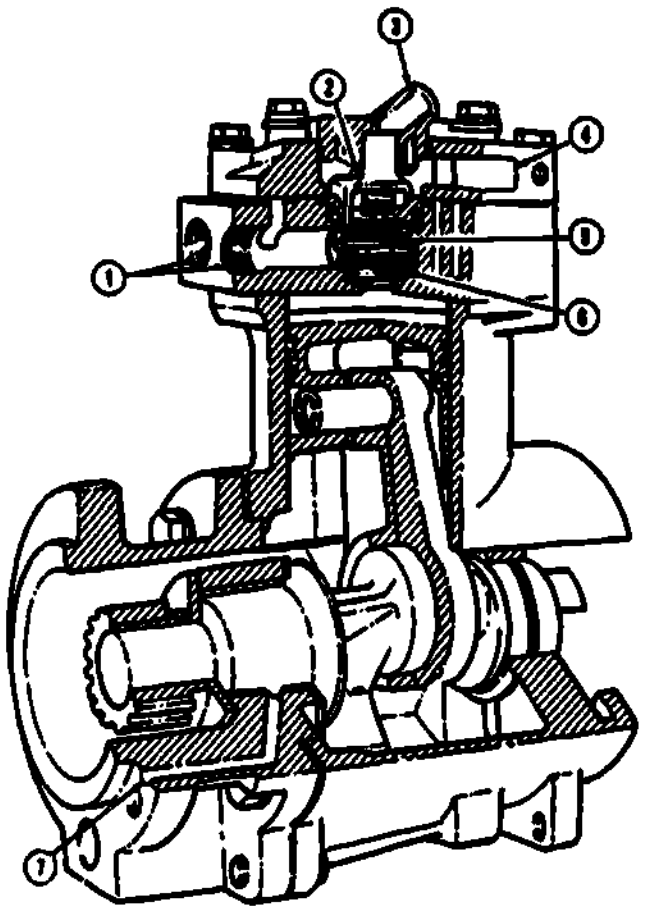
Fig 2-2. Air Supply Line Diagram

2-3

Air Compressor (fig 2-3,

An air compressor of one or two cylinders provides compressed air for use in the operation of the brakes and other equipment on the vehicle. The compressor runs continuously with the engine operation. It can be belt driven or gear driven and is normally mounted on the engine to provide lubrication and cooling from the engine's lubrication and cooling system. In some applications, the compressor may be air cooled.

The compressor operation is controlled by a governor acting with an unloader mechanism to regulate air pressure within operational limits.



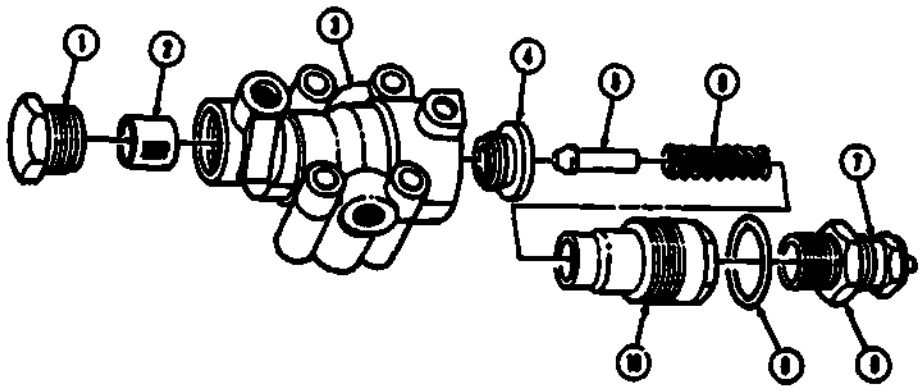
1. Coolant Inlet and Outlet Ports
2. Unloader Valve
3. Air Governor Connection
4. Air Inlet
5. Intake Valve
6. Exhaust Valve
7. Lubrication Passage

Fig 2-3. Air compressor and unloader assembly.

Governor (fig 2-4)

The governor controls the amount of pressure in the air supply system and is normally mounted on or near the compressor.

The governor uses the air pressure in the primary reservoir applied to a spring loaded valve. When the maximum air pressure (127 pounds per square inch), the spring loaded valve is moved off its seat and air pressure is directed to the unloaded assembly, discontinuing the operation of the compressor. Anytime the air pressure in the primary reservoir is below the minimum operating limit (normally 90 pounds per square inch), the spring loaded valve in the governor will keep the unloader from deactivating the compressor. This maintains a supply of air pressure in the reservoir (normally 90 psi to 120 psi).



1. Filter Cap
2. Filter
3. Governor Body
4. Valve Assembly
5. Plunger
6. Spring
7. Adjuster Stem
8. Locknut
9. O-Ring
10. Adjuster Body

Fig 2-4. Governor assembly.

Unloader Mechanism (refer to fig 2-3)

The unloader mechanism, when activated by the governor (at maximum 120 psi), unloads the compressor by opening the exhaust valve and, at the same time, closing the intake valve. This stops the compressor from supplying air to the reservoirs. When the pressure in the air system is below 90 psi, the governor deactivates the unloader assembly which allows the compressor to supply compressed air to the reservoir until maximum pressure is obtained. The action of the governor and unloader mechanism maintains the air pressure within the operating limits of the system. The function of the unloader mechanism is to load or unload the compressor, thereby, maintaining the pressure in the brake system within operating limits.

Reservoirs, Pressure Relief Valve and Drain Cocks (fig 2-2)

Air reservoirs are tanks which are designed to store air pressure. This establishes a quantity of pressure to operate the brakes when needed and to maintain an amount of reserve pressure for use when the compressor fails to operate.

As previously stated, the governor maintains the air pressure within operating limits. If the governor or unloader mechanism fails to stop the compression of air, a pressure relief valve (safety valve) will automatically open to expel excessive pressure (above 150 psi) in the reservoir. If the internal pressure within the reservoir tanks is allowed to exceed its design characteristics the reservoir tanks could rupture with the force of a bomb.

Upon compression, the air temperature rises. When the hot, humid air cools in the wet reservoir, the humidity condenses and water accumulates in the tank. To remove the condensation (water) from the air reservoir, a drain cock is installed at the lowest point. If allowed to enter the working parts of the air brake system, water could cause the valves and brake chambers to be inoperative. Therefore, condensation (water) must be drained from all tanks daily.

The routing of the air pressure to the various components is accomplished by copper or nylon tubing. If leaks occur in the tubing, the repair or fabrication of a new line is necessary. After the length of the line is determined, the new line must be flared with a double lap flare as indicated in the TM.

Pressure Gage and Warning Buzzer

The operator may monitor the air pressure by observing the air pressure indicator mounted on the instrument panel. The operational range should be maintained between 90 psi

and 120 psi. When the minimum air pressure has not been obtained or falls below the minimum operating level a warning buzzer will sound alerting the operator that the necessary operating pressure is not present in the system. The pressure gage and low pressure warning buzzer must be operational at all times. If not operational, the air pressure may be either too low tooperate the brakes or too high due to a malfunctioning governor assembly. Either condition is dangerous.

Caution: Whenever disconnecting any line or component on an air brake system, first drain the air reservoir completely.

EXERCISE: Answer the following questions and check your responses against those listed at the end of this study unit.

1. State the function of the air compressor.

_____

2. What is the function of the governor assembly.

_____

3. State the function of the unloader assembly.

_____

4. The function of the reservoir tanks is to_____

5. What is the function of the pressure relief valve?

_____

6. State the functinn of the drain cocks on the reservoir tanks.

_____

7. What is the function of the copper or nylon lines?

_____

8. The function of the pressure indicator is to_____

9. The function of the warning buzzer is to_____

10. Why must the pressure indicator and warning buzzer be operational at all times?

    a. To warn the operator of a malfunction in the air supply system

    b. To indicate that the system has too much pressure

    c. To warn the operator of a malfunction in the control system

    d. To warn the operator that the brakes will not work

11 What is the normal operating air pressure for an air brake system?

_____

Work Unit 2-3. AIR CONTROL SYSTEM

STATE THE FUNCTIONS OF EACH OF THE SIX COMPONENTS IN THE AIR CONTROL SYSTEM.

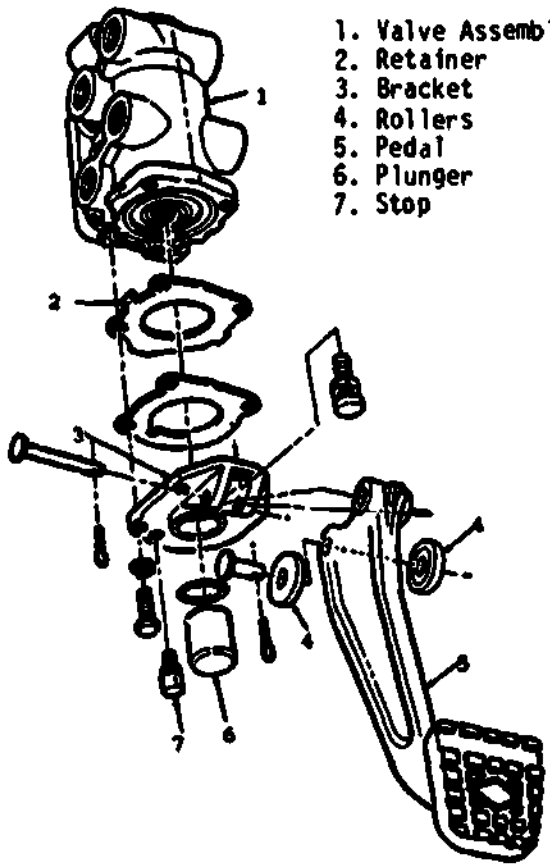
DESCRIBE THE FUNCTION OF THE AIR VENT SYSTEM.

The application of brakes is accomplished by pressing on a pedal with your foot. When the pedal is depressed, air is routed through the control system (fig 2-6) to several valves and finally, to brake chambers which apply force to the brake shoes by one of two methods. Routing of the air pressure is accomplished through lines as was covered in work unit 2-2. The function of the brake chamber and the two methods of forcing brake shoes apart will be discussed later in this study unit. For maintenance and repair of the individual items refer to the respective TM.

Brake application (treadle) valve (fig 2-5)

Operation of the treadle valve regulates the movement of an inlet valve and exhaust valve controlling the application of air pressure to or from the brake chambers. The function of the brake (treadle) valve is, therefore, to control air pressure delivered to or from the brake chambers. In other words, the treadle valve applies and releases the brake on the vehicle.

The brake (treadle) valve operates on a pressure equalization principle. As you press on the brake pedal with your foot, there is a certain amount of force applied to the treadle valve. This force is equalized with air pressure and that amount of air pressure (force) is directed through the control system to apply the brakes on the vehicle. When your foot is removed from the brake pedal, the force is removed from the treadle valve and the excess air pressure in the control system is vented to the atmosphere.



1. Valve Assembly
2. Retainer
3. Bracket
4. Rollers
5. Pedal
6. Plunger
7. Stop

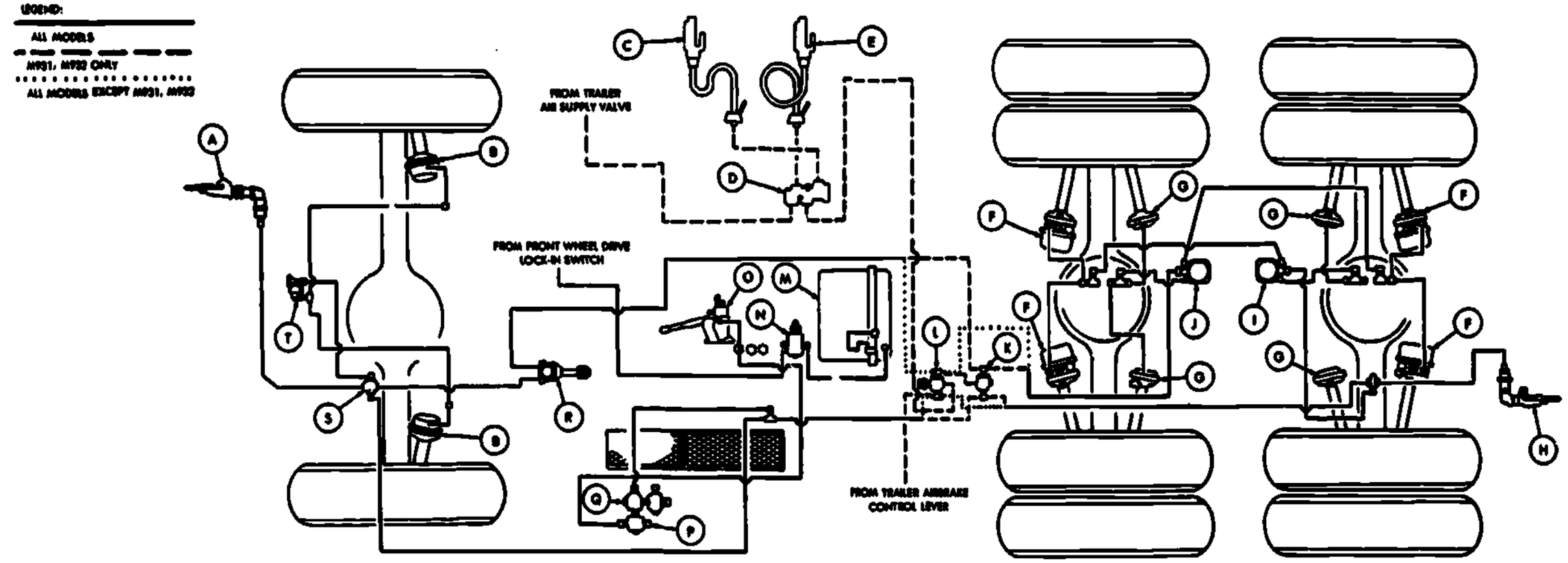
Fig 2-5. Brake application (treadle) valve.

Relay valve (fig 2-7)

Relay valves control the application of air pressure to the rear wheel brake on tandem axle or long wheel base vehicles. The relay valve is operated by air pressure from the treadle valve on the pressure equalization principle. Relay valves are sensitive to slight changes of pressure from the treadle valve. An air supply directly from the reservoir makes the relay valve act as a remote application valve to speed up the application and release of the rear brakes.

As foot pressure is applied to the treadle valve, air pressure is directed through the control system lines to the relay valve. The relay valve then directs air pressure from the supply system to the brake chambers. Force applied at the brake chambers is controlled by the control system pressure equalization in the relay valve. Upon release of the brakes the air pressure in the brake chambers is vented to the atmosphere.

ALL MODEL VEHICLES



- (A) FRONT SERVICE AIR COUPLING
- (B) FRONT SERVICE BRAKE CHAMBER
- (C) SERVICE TRAILER COUPLING (M931, M932 ONLY)
- (D) TRAILER PROTECTION VALVE (M931, M932 ONLY)
- (E) EMERGENCY TRAILER COUPLING (M931, M932 ONLY)
- (F) COMBINATION SPRING AND SERVICE BRAKE CHAMBER
- (G) REAR SERVICE BRAKE CHAMBER
- (H) REAR SERVICE AIR COUPLING
- (I) PRIMARY RELAY VALVE
- (J) SECONDARY RELAY VALVE
- (K) DOUBLECHECK VALVE #5 (M931, M932 ONLY)
- (L) DOUBLECHECK VALVE #2
- (M) TRANSFER CASE
- (N) TRANSFER CASE ACTUATOR VALVE
- (O) PARKING BRAKE VALVE
- (P) DOUBLECHECK VALVE #4
- (Q) DOUBLECHECK VALVE #3
- (R) BRAKE PEDAL (TREADLE) VALVE
- (S) DOUBLECHECK VALVE #1
- (T) FRONT LIMITING VALVE

Fig 2-6. Air Control Line Diagram.

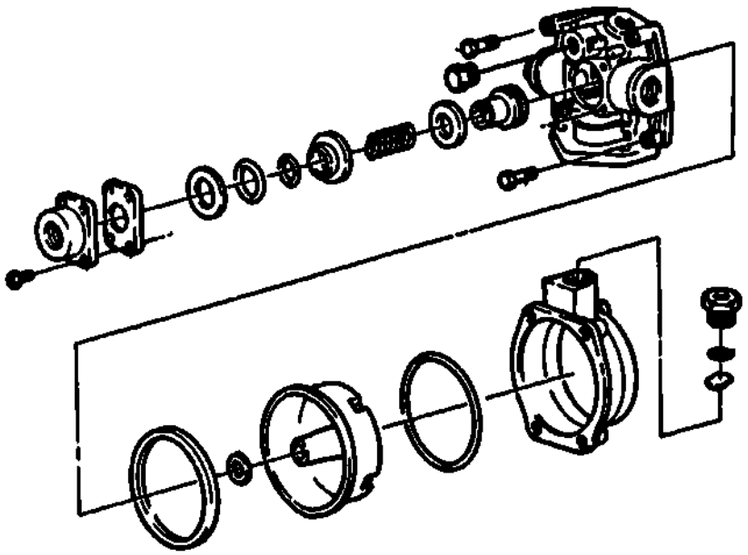


Fig 2-7. Rear air brake relay valve (exploded).

Front limiting valve (fig 2-8)

If full pressure was to be applied to the front brake chambers, the front wheels would probably lock before the rear wheels. When front wheel braking occurs before rear wheel braking, the vehicle is difficult to control. Therefore, a limiting valve is used on the front axle control line. This valve limits the pressure directed to the front brake chambers. Hence, a front limiting valve prevents front wheel lockup before rear wheel braking providing better control of the vehicle. The limiting valve also vents air pressure in the front brake chambers to the atmosphere upon command of the treadle valve.

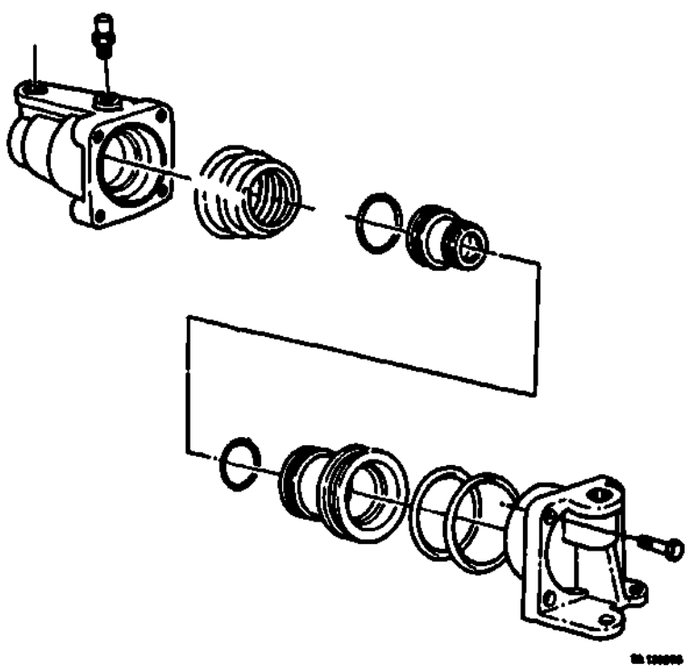


Fig 2-8. Front air brake limiting valve (exploded).

Hand control valve

The hand control valve on the truck-tractor controls the application of brakes on the towed vehicle only. This is done by a lever assembly mounted on the steering column which

directs air to the towed vehicle's brake system through the towed vehicle's service connector. In this case, the towing vehicle's air system is connected to the towed vehicle's air system by flexible hoses.

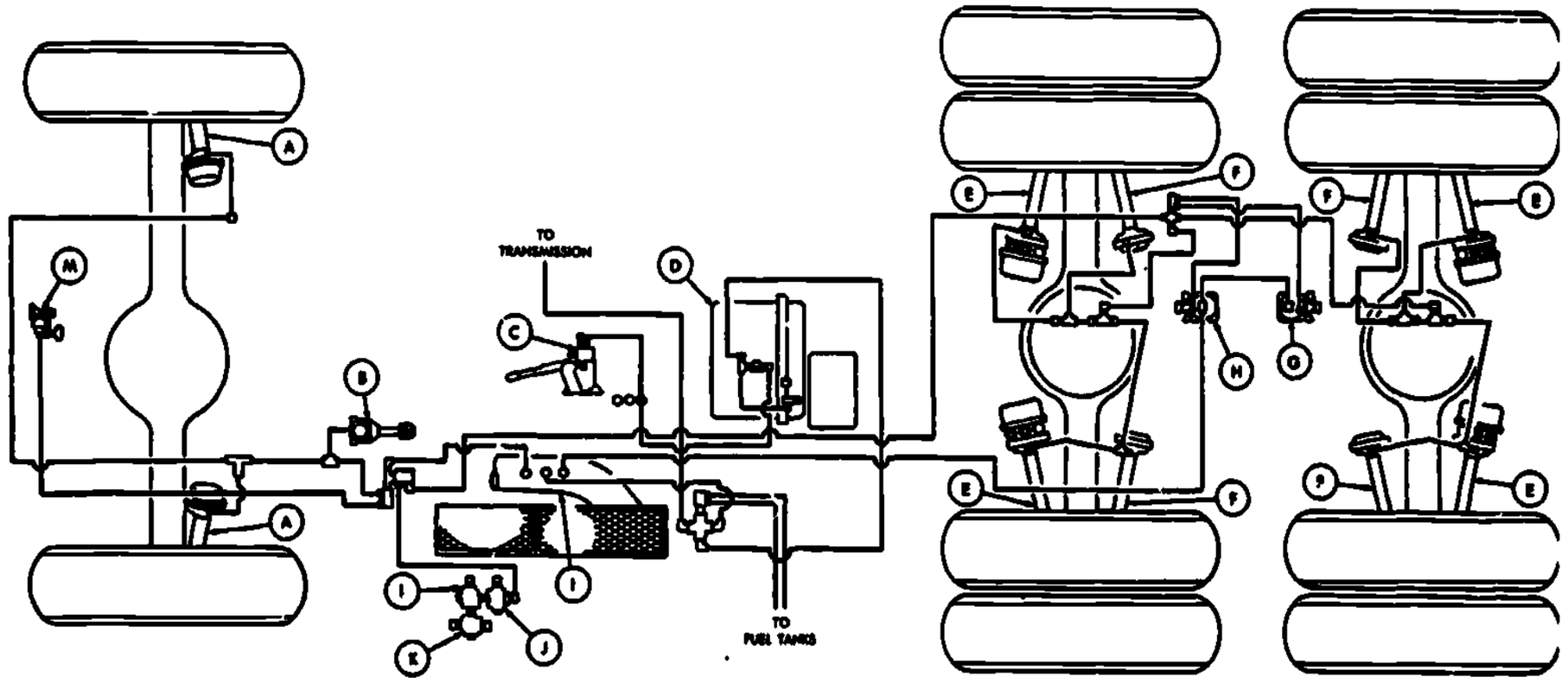
Check valve

The single check valve is installed in the supply line to prevent the air pressure from reversing direction. If the pressure in the wet supply reservoir falls below that of the secondary reservoir, the check valve will remain closed, thus preserving the air supply in the secondary reservoir.

Double check valves are installed in several points in the control system to allow application of air from two sources in a common line. A double check valve is used to tie the front and rear air system together. It is also used in the control line to the trailer brakes, the hand control valve, and spring brakes. For example, a double check valve in the control line from the brake application (treadle) valve to the rear service connection (fig 2-5, items S & L) allows the trailer brakes to be applied by pressing on the brake pedal or by using the hand control valve on the steering column.

Air Vent System (fig 2-9)

The application of air brakes on a vehicle involves directing the air pressure to the brake chambers. When brakes are no longer required, the vent lines direct (vent) the air pressure to the atmosphere upon command of the treadle valve. When foot pressure is released at the treadle valve, the pressure equalization action reverses and controls air pressure vented into the air intake stack. This reduces or eliminates the controlling pressure in the relay and limiting valves which, in turn, also vent the air pressure in the brake chambers into the air intake stack or atmosphere.



(A) FRONT SERVICE BRAKE CHAMBER
(B) BRAKE PEDAL (TREADLE) VALVE
(C) PARKING BRAKE VALVE
(D) TRANSFER CASE
(E) COMBINATION SPRING AND SERVICE BRAKE CHAMBER
(F) REAR SERVICE BRAKE CHAMBER
(G) PRIMARY RELAY VALVE
(H) SECONDARY RELAY VALVE
(I) AIR INTAKE STACK
(J) QUICK-RELEASE VALVE
(K) DOUBLECHECK VALVE #4
(L) DOUBLECHECK VALVE #3
(M) FRONT LIMITING VALVE

Fig 2-9. Air Vent Line Diagram.

EXERCISE: Answer the following questions and check your responses against those listed at the end of this study unit.

1. State the functions of each of the following components in the air control system.

   a. Treadle valve:_____

   b. Relay valve:_____

   c. Front limiting valve:_____

   d. Hand control valve:_____

   e. Single check valve:_____

   f. Double check valve:_____

2. Describe the function of the air vent system.

   _____

Work Unit 2-4. WEDGE ACTUATED WHEEL BRAKE

IDENTIFY THE AIR BRAKE ACTUATION OF THE M939 SERIES VEHICLE BRAKE SHOES.

IDENTIFY WHY THE SPIDER (BACKING PLATE) MUST BE INDEXED ACCORDING TO WHEEL ROTATION.

STATE THE FUNCTION OF THE SERVICE BRAKE CHAMBER.

STATE THE FUNCTION OF THE COMBINATION BRAKE CHAMBER.

STATE THE FUNCTION OF THE WEDGE.

STATE THE FUNCTION OF THE PLUNGER ASSEMBLY.

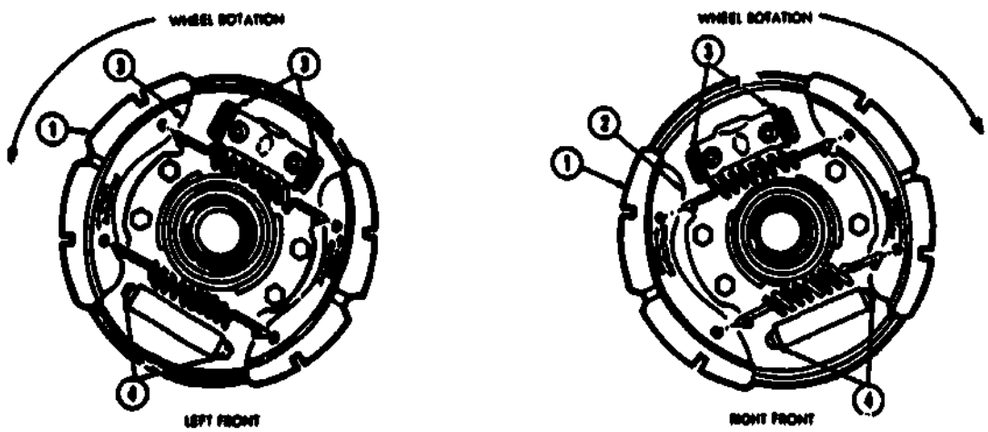
DESCRIBE THE ADJUSTMENT MADE ON BRAKE CHAMBERS.

STATE WHEN BRAKE SHOES MUST BE ADJUSTED.

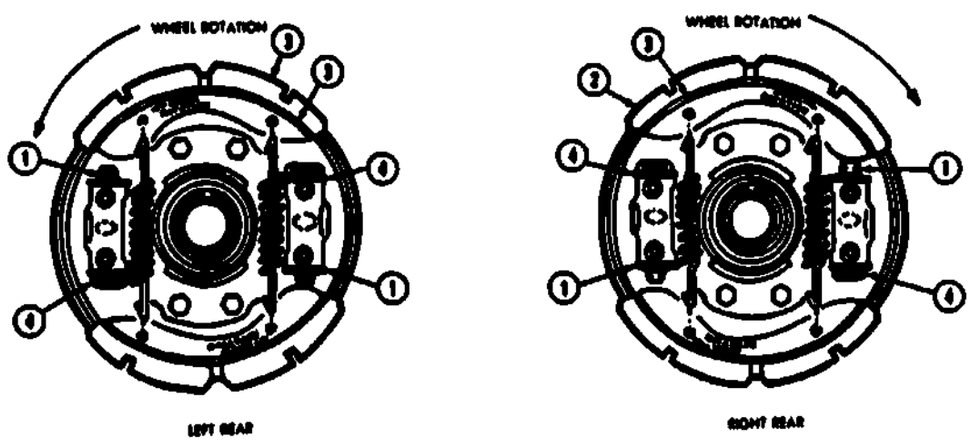
In the M939 series and M970 vehicles, the brakes on each wheel are actuated by a wedge system in combination with an air brake chamber. The commercial name for this system is "Stopmaster Brakes." The wedge assembly is forced between tapered plungers causing the brake shoes to contact the brake drum. Other vehicles use a cam and lever assembly which will be discussed in work unit 2-5.

Spider assembly

The spider assembly (backing plate) provides a base for the non-rotating brake surfaces (brake shoes) and the associated actuating devices. Spiders must be indexed as indicated in fig 2-10 according to wheel rotation to prevent damage to other brake components. An adjustable plunger assembly and anchor plunger assembly is mounted on the front wheel spiders. The adjustable plunger assembly is the device that forces the brake shoes outward to contact the brake drum upon movement of the wedge assembly. The spiders on rear axles have an adjustable plunger and anchor plunger for each brake shoe. The rear wheel brakes have a service brake chamber and a combination brake chamber on each wheel while each front wheel has only a service brake chamber.



1. Shoe Lining
2. Shoe Web
3. Adjustable Plunger Star Wheel
4. Anchor Plunger



1. Anchor Plunger
2. Shoe Lining
3. Shoe Web
4. Adjustable Plunger Star Wheel

Fig 2-10. Indexing of spider assembly.

Service brake chamber (fig 2-11)

The service brake chamber is a diaphragm over a plate and rod assembly encased in an air tight container. When air pressure is applied, the rod is pushed into the actuating device (wedge) in the brake actuating assembly. Therefore, the function of the service brake chamber is to apply the necessary force to the brake shoes in order to slow or stop the vehicle. Brake chambers have tapered threads which automatically adjust the space between the rod and wedge assembly. No adjustment is required.

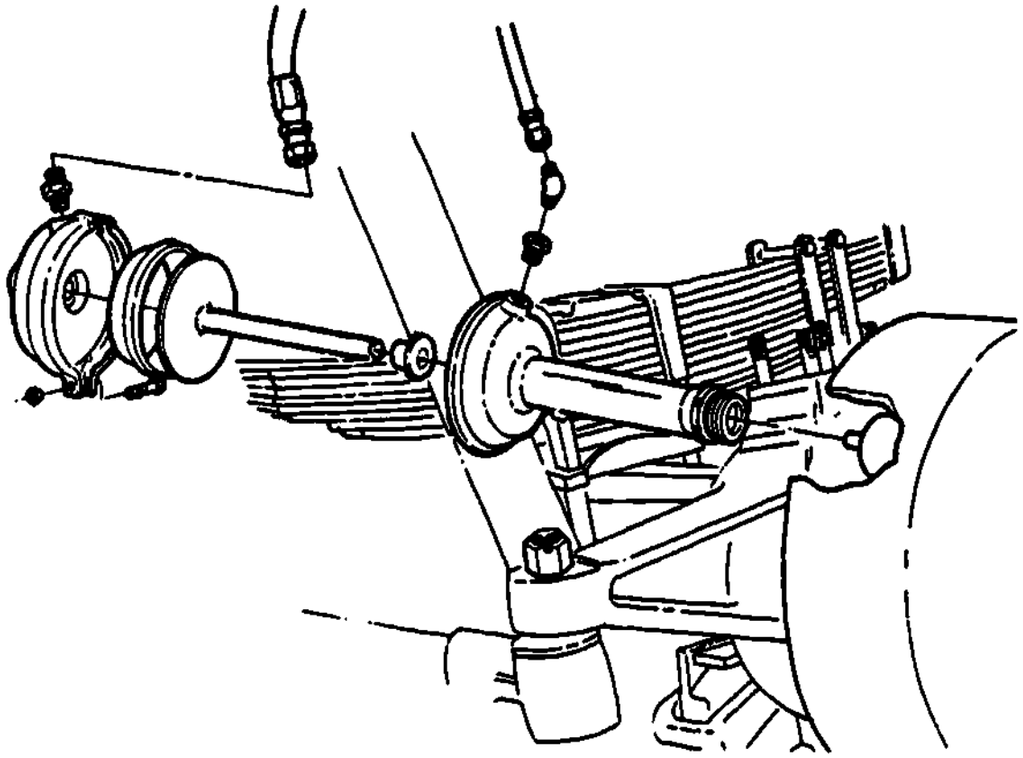


Fig 2-11. Service brake chamber.

Combination brake chamber (fig 2-12)

The combination brake chamber is, essentially, a service brake chamber with a spring actuating device attached. The function of the combination brake chamber is to apply the service brake and provide an auxiliary method of applying brakes. Spring brakes will be discussed in study unit 4.

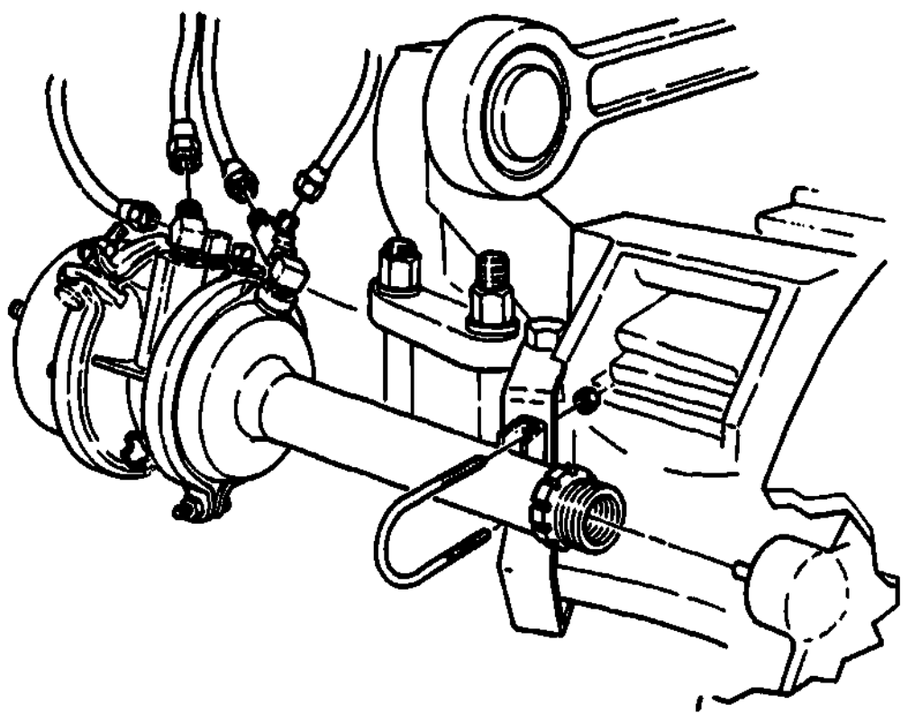
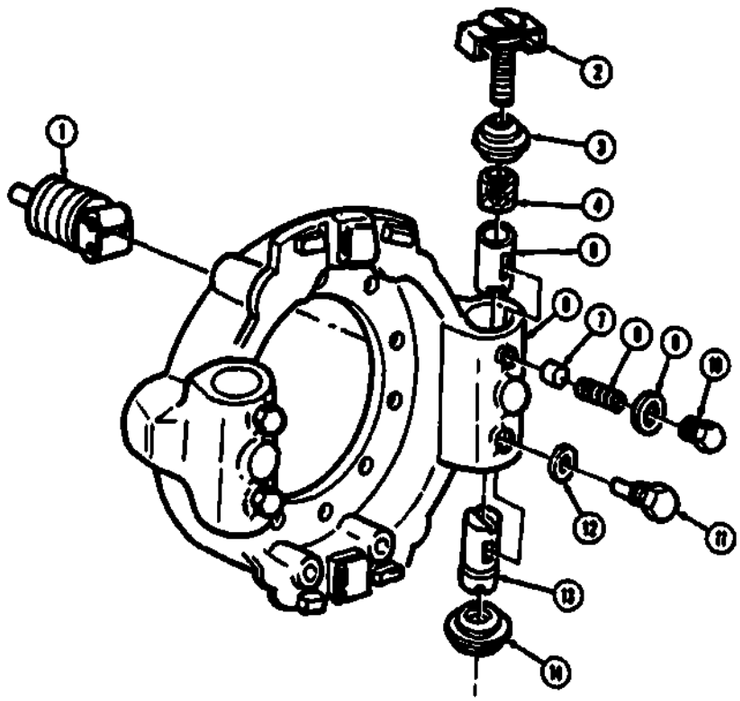


Fig 2-12. Combination brake chamber.

Wedge Assembly (fig 2-13)

The major difference between the stopmaster brake system and the cam and lever brake system is the method of forcing the brake shoes against the brake drum. The stopmaster system used on the M939 series vehicle uses the wedge. In this system of actuating brakes, the brake chamber forces a wedge between two tapered plungers which connect to the web of the brake shoes. The wedge assembly has rollers to ease the application and withdrawal of force. When installing the wedge, insure that the rollers are alined with the tapered portion of the plungers.



1. Wedge Assembly
2. Adjusting bolt
3. Seal
4. Adjusting sleeve
5. Adjusting Plunger
6. Plunger housing
7. Pawl
8. Spring
9. Gasket
10. Capscrew
11. Screw
12. Gasket
13. Anchor plunger
14. Seal

Fig 2-13. Brake actuator assembly.

Plunger Assembly (fig 2-13)

The function of plungers in the stopmaster brake system is to transmit force perpendicular to the input force, and to provide a means of adjustment to components for brake lining wear. In other words, the brake chamber transmits motion in a straight line between the plungers, forcing them outward. Since the brake shoes rest on the plungers, the shoes are also forced outward to the braking surface of the drum. Insure the plungers are properly alined with the wedge assembly upon installation.

As brakes are used, the linings wear down and must be adjusted. All vehicles are equipped with a method of adjusting the brake shoes in order to prevent excessive pedal travel and eventually poor or no braking action. The stopmaster brake system used on military vehicles has self adjusters integrated with the plungers. This method automatically compensates for lining wear. When brake shoes are replaced, adjustment is necessary to prevent unequal braking; however, after the initial adjustment is made, no other adjustment is required until the shoes are again replaced.

EXERCISE: Answer the following questions and check your responses against those listed at the end of this study unit.

1. What type actuation of brake shoes is used with the stopmaster brake system on the M939 series vehicles?

   a. Wheel cylinder

   b. Cam and lever

   c. Wedge

   d. Air-hydraulic cylinder

2. Why must the spider assembly be indexed according to the wheel rotation on the M939 stopmaster brake system?

   a. To provide better braking

   b. To prevent damage to the other components

   c. To make it easier to repair

   d. To provide for self-energization

3. State the function of the service brake chamber.

   _____

4. What is the function of the combination brake chamber?

   _____

5. The function of the wedge in the actuator assembly is

   _____

6. What is the function of the plunger assembly in the actuator assembly?

   _____

7. What adjustment is made on the service or combination brake chambers?

   _____

8. When must the brake shoes be adjusted on the M939 stopmaster brake system?

   _____

Work Unit 2-5. CAM AND LEVER ACTUATED BRAKES

STATE THE FUNCTION OF THE CAM.

LIST THE TWO FUNCTIONS OF THE SLACK ADJUSTER.

DESCRIBE HOW TO ADJUST THE BRAKE SHOES TO COMPENSATE FOR WEAR.

Older model vehicles in the military, the M123 10-ton tractor for instance, use a different method of actuating the brake shoes--a cam and lever with an air brake chamber. Other components of the air system are similar to those discussed earlier in this study unit. For repair and maintenance information refer to the appropriate TM. Brake chamber and air system component operation and function in either the "Stopmaster" or the cam and lever systems are the same.

The M123 10-ton tractor and larger trailers use the cam and lever method of applying force to the brake shoes. The cam is a rod which extends through the backing plate with an "S" shaped area on one end. At the other end of the rod a lever or slack adjuster is attached. As the lever (slack adjuster) is moved by the brake chamber, the cam turns and applies force to the brake shoes thereby stopping the vehicle. The cam is identified in fig 2-14 by the definitive "S" shape on the left side.

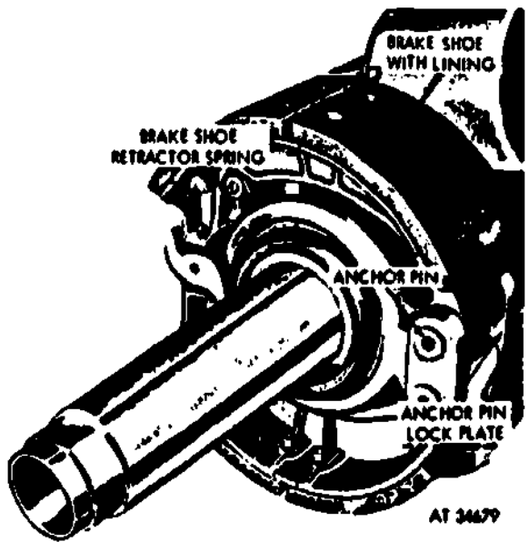


Fig 2-14. Brake shoe anchor points.

Note that each brake shoe is anchored to the backing plate. In the cam and lever system, one brake chamber or combination chamber is used on each wheel.

Slack adjuster (lever)

Air brakes, when applied, must apply force to the brake shoes. In the cam and lever system of actuating wheel brakes, a slack adjuster (lever) is used to transfer the actions of the brake chamber to the cam which in turn expands the brake shoes to contact the brake drum. A slack adjuster is a lever with a means of adjustment to compensate for lining wear (fig 2-15). Therefore, the functions of a slack adjuster are; to transfer a lineal mechanical force to a twisting force applying the wheel brake, and to provide a point of adjustment for lining wear. Adjustment is performed by turning the adjusting screw on the slack adjuster until the space between the brake shoe and drum is within specification as stated in the TM of the respective vehicle.

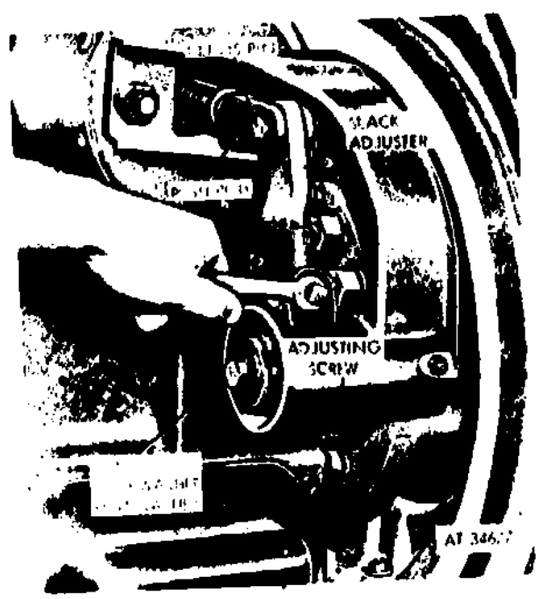


Fig 2-15. Adjusting service brakes.

EXERCISE: Answer the following questions and check your responses against those listed at the end of this study unit.

1. State the function of the cam in an air brake system.

   _____

2. List the two functions of the slack adjuster in an air brake system.

   a. _____

   b. _____

3. How do you adjust the brake shoes to compensate for lining wear?

   _____

   _____

SUMMARY REVIEW

In this study unit, you learned the property of compressed air used in the air brake systems. You learned the resulting force obtained by a brake chamber. You also learned the function of each component within the air brake system and how it operates.

Answers to Study Unit #2 Exercise

Work Unit 2-1.

1. similar to that of liquid
2. c

Work Unit 2-2.

1. To provide compressed air for use in the operation of brakes
2. To control the amount of pressure in the air supply system
3. To load or unload the compressor as directed by the governor
4. maintain a supply of air pressure for use by the brake system.
5. To relieve excessive pressure in the reservoir
6. To remove condensation (water) from the air supply system
7. To direct air pressure to the various components
8. allow the operator to monitor the pressure in the air system and detect a malfunction
9. warn the operator of low pressure in the air system.
10. a
11. 90 psi to 120 psi

Work Unit 2-3.

1. a. To control air pressure delivered to or from the brake chambers

   b. To control the application of air pressure to the rear wheel brakes on tandem axle or long wheel base vehicles

   c. To limit the pressure directed to the front wheel brake chambers

d. To apply only the towed vehicle brakes

e. To prevent air pressure from reversing direction in the reservoirs

f. To allow application of air from two sources in a common line

2. To vent air pressure to the atmosphere upon release of the brakes

Work Unit 2-4.

1. c

2. b

3. To apply force to the brake shoes in order to stop the vehicle

4. To apply the service brakes and provide an auxiliary method of applying brakes
5. To force the plungers outward thereby engaging the brake shoes with the brake drum

6. To transmit force perpendicular to the input force of the wedge and provide a means of self adjustment

7. No adjustment is necessary

8. Upon replacement of the shoes

Work Unit 2-5.

1. To apply force to the brake shoes

2. a. To transfer a lineal motion the brake chamber to a turning motion on the cam

b. To provide a point of adjustment to compensate for lining wear

3. By turning the adjusting screw on the slack adjuster until the space between the brake shoe and drum is within specifications

STUDY UNIT 3

POWER BRAKES

STUDY UNIT OBJECTIVE: WITHOUT THE AID OF REFERENCES, YOU WILL IDENTIFY THREE TYPES OF POWER ASSIST BRAKE UNITS USED ON MILITARY VEHICLES AND THE FUNCTION OF EACH. YOU WILL ALSO IDENTIFY THE PRINCIPLE OF OPERATION OF EACH POWER UNIT.

Work Unit 3-1. VACUUM ASSISTED POWER BRAKES

STATE THE TYPE OF POWER USED BY THE POWER BRAKE UNIT ON THE HIGH MOBILITY MULTI-PURPOSE WHEELED VEHICLE (HUMMV), COMMERCIAL UTILITY CARGO VEHICLE (CUCV) AND M880 VEHICLE.

STATE WHY POWER ASSISTED BRAKES ARE USED ON VEHICLES.

STATE THE FUNCTION OF THE VACUUM ASSISTED UNIT IN THE POWER BRAKE SYSTEM.

LIST THE TWO FORCES CONTROLLED BY DEPRESSING OR RELEASING THE BRAKE PEDAL IN THE OPERATION OF THE VACUUM POWER ASSISTED UNIT.

IDENTIFY WHAT MUST BE CHECKED WHEN EXCESSIVE PRESSURE EXISTS WITH THE APPLICATION OF THE BRAKES.

Newer vehicles, such as the M880, presently used in the Marine Corps are designed with vacuum power assisted hydraulic brake systems. This system uses the existing hydraulic brake system (discussed in study unit I) with a vacuum power unit placed between the brake pedal and master cylinder. The power unit assists the operator in stopping the vehicle by using the vacuum produced by the engine or a vacuum pump. This reduces the pressure applied to the brake pedal. For repair and maintenance information refer to the appropriate TM.

The vacuum power unit is a closed chamber containing a diaphragm and a rod with a means of controlling vacuum and atmospheric pressure (fig 3-1). As the brake pedal is depressed, a vacuum valve closes. The atmospheric air pressure pushes the diaphragm toward the partial vacuum chamber. This causes the rod to move, with the added force produced by the vacuum thereby applying power to the hydraulic master cylinder. When foot pressure is released from the brake pedal, a vacuum is again created on both sides of the diaphragm. Spring pressure moves the diaphragm and rod to the rear most (released) position. In short, the vacuum power unit changes to mechanical force which assists the application of hydraulic brakes.

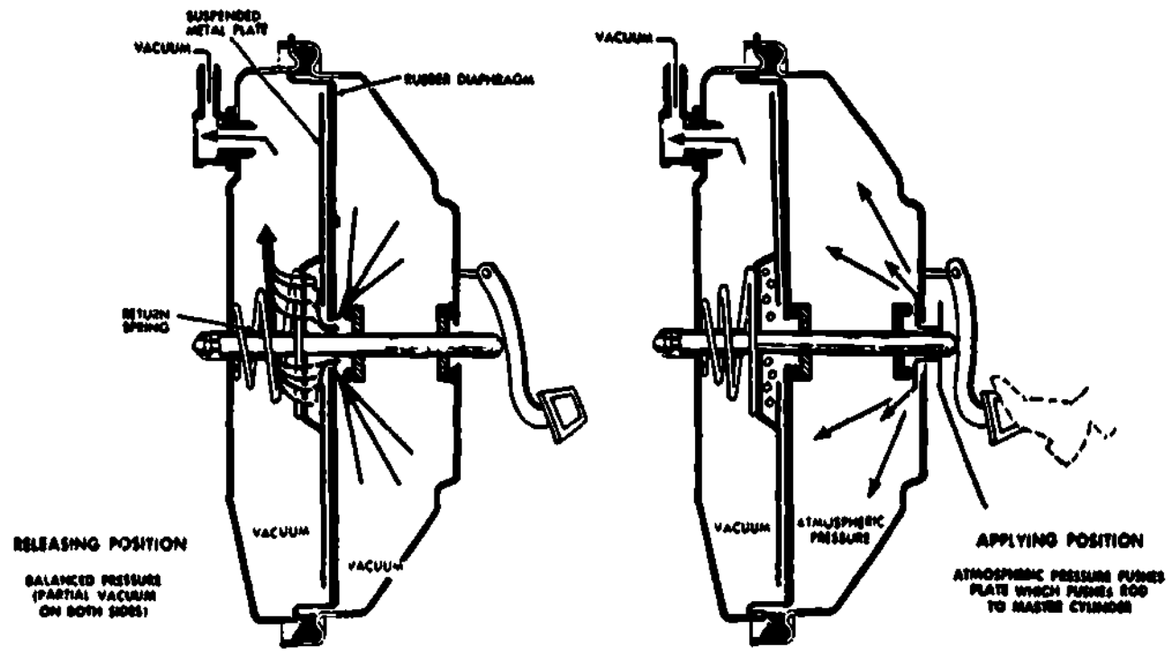


Fig 3-1. Principle of operation of the vacuum suspended power brake booster.

Another type of vacuum power booster unit, the vacuum-atmospheric suspended unit, uses the same principle except that the diaphragm has atmospheric pressure on both sides. The opening of the controlling vacuum valve allows the engine vacuum to create a partial vacuum on one side of the diaphragm. At the same time, atmospheric pressure is not allowed to enter the partial vacuum area. The partial vacuum area is always on the master cylinder side of the power unit which allows atmospheric pressure to assist in applying the brake.

If excessive pressure is noted in the application of vacuum power brakes, check the engine vacuum system lines for leaks. A loss of vacuum will cause excessive pressure on the brake pedal; therefore, the vacuum system must be maintained without leaks. In military applications, the power unit must be replaced if found to be defective. The power unit is sealed to avoid the creation of vacuum leaks.

The addition of a vacuum power unit does not affect the hydraulic system components; it makes it easier for the operator to stop the vehicle.

EXERCISE: Answer the following questions and check your responses against those listed at the end of this study unit.

1. What type of power is used to assist the hydraulic brake system on the M880?

   _____

2. Why are power assisted brakes used on vehicles?

   _____

3. What is the function of a vacuum assist unit in the brake system?

   _____

4. In the operation of a vacuum assist unit, what two forces are controlled by depressing or releasing the brake pedal?

   a. _____

   b. _____

5. What would be checked if excessive pressure is noted on the brake pedal when the brakes are applied?

   _____

6. What would cause excessive brake pedal pressure on vacuum powered brakes?

   _____

Work Unit 3-2. AIR ASSISTED HYDRAULIC BRAKE SYSTEM

IN THE 2-1/2 AND 5-TON VEHICLE, NAME THE COMPONENT WHICH INCREASES THE HYDRAULIC PRESSURE BY USING AIR PRESSURE.

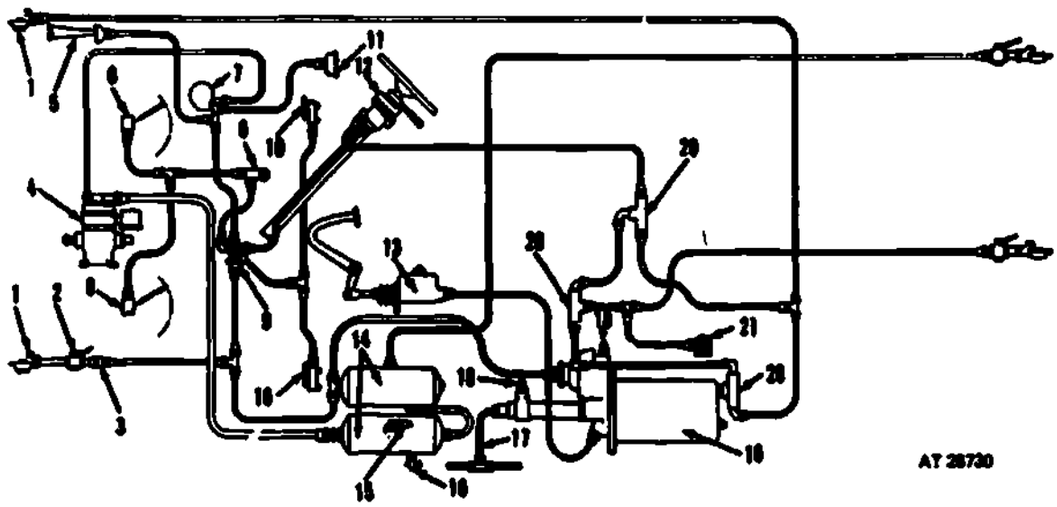
STATE WHAT OPERATES THE CONTROL VALVE.

STATE THE FUNCTION OF THE SLAVE UNIT.

LIST THE THREE COMPONENTS OF THE AIR HYDRAULIC CYLINDER.

The Marine Corps' 2 1/2 and 5-ton multifuel powered and M800 series trucks incorporate an air hydraulic cylinder which is used to boost the hydraulic braking effect. In fig 3-2 notice that the air hydraulic cylinder is located between the master cylinder, which activates the unit and the wheel cylinder. The air hydraulic brake system consists of a straight hydraulic system plus those of the compressed air system.

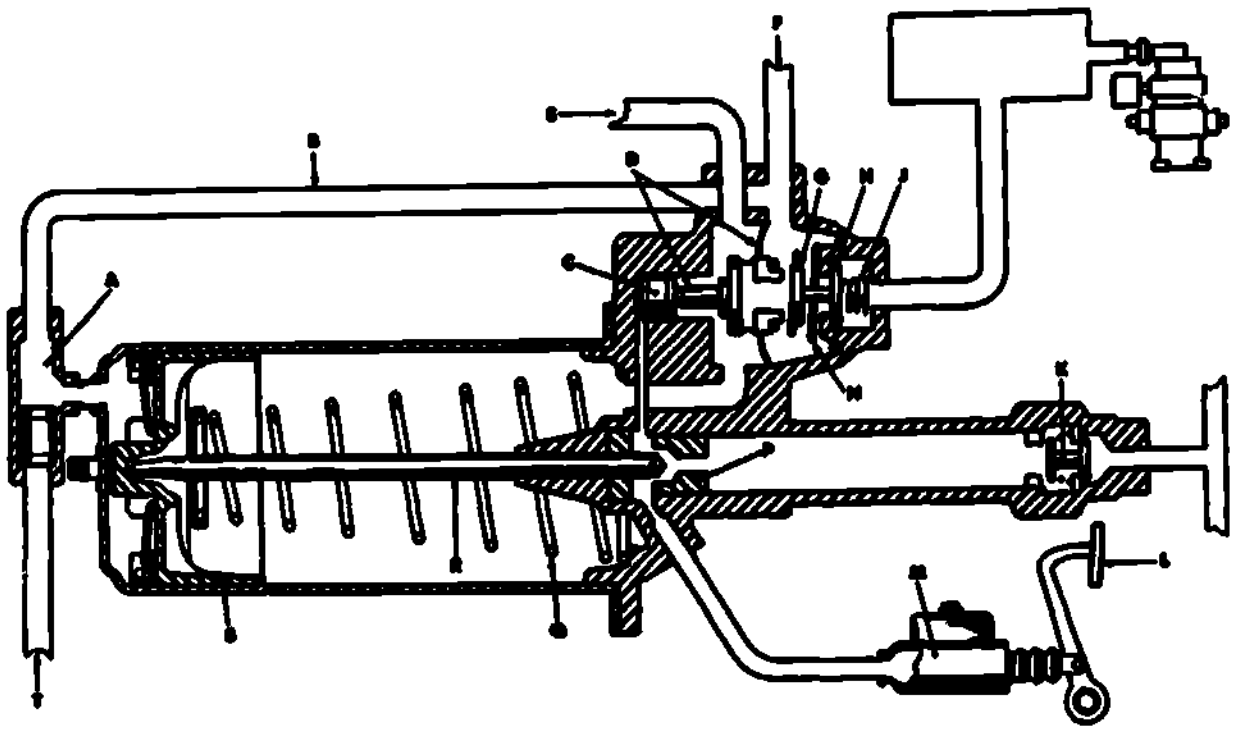
Components of the hydraulic system are identified to the system discussed in study unit 1. Also, the components of the air system, compressor, governor, reservoirs, and lines are similar to the components discussed in study unit 2. This work unit will only cover the air hydraulic cylinder which uses the air system to assist the hydraulic system. For repair and maintenance information refer to your respective TM.



1. Trailer coupling
2. Trailer coupling cutout cock
3. Single check valve
4. Air compressor
5. Horn
6. Windshield wiper
7. Air governor
8. Windshield wiper control valve
9. Junction block
10. Air supply valve
11. Air pressure gage sending unit
12. Hand-control valve
13. Master cylinder
14. Air reservoir
15. Air reservoir safety valve
16. Air reservoir drain cock
17. Hydraulic line to wheel cylinder
18. Hydraulic bleeder valve
19. Air hudraulic brake cylinder
20. Double check valve
21. Stop light switch

Fig 3-2. Compressed air system.

When hydraulic pressure from the master cylinder activates the air-hydraulic cylinder, compressed air boosts the hydraulic pressure to the wheel cylinders. Air hydraulic cylinders (fig 3-3) house three major units in one assembly. The units are the control unit, the power cylinder, and the slave cylinder.



A. Double check valve
B. Air control line
C. Relay piston
D. Diaphragm assembly
E. Exhaust port
F. Atmospheric inlet
G. Atmospheric poppet open
H. Air pressure poppet closed
J. Poppet return spring
K. Residual line check valve
L. Brake pedal
M. Master cylinder
N. Diaphragm return spring
P. Hydraluic piston
Q. Piston return spring
R. Push rod
S. Power piston
T. Trailer connection

Fig 3-3. Air hydraulic power cylinder schematic diagram.

Control Unit (the upper part of fig 3-3). The control unit contains a control valve (relay) piston, which is hydraulically operated by brake fluid from the master cylinder, and a diaphragm or compensator assembly, which is operated by pressure differences between brake fluid and air spring pressure. A return spring holds the hydraulic relay piston and diaphragm assembly in the released position when there is no hydraulic pressure. Two air poppet valves, assembled on one stem, control the air pressure flowing into and out of the power cylinder. The poppet valves are normally held in the released position by the poppet return spring.

Power Cylinder (the left part of fig 3-3). The power cylinder consists of a cylinder, piston, piston rod, and piston return spring. Air pressure admitted at the head end of the cylinder compresses the piston return spring extending the piston rod toward the slave cylinder. When the air pressure is released, the spring retracts the rod. Air in the rod end of the cylinder can pass freely in and out of the cylinder through a breather air line that is attached to the air intake system of the vehicle. A lip-type piston seal prevents air pressure from leaking between the piston and cylinder wall.

Slave Cylinder (the right part of fig 3-3). The slave cylinder is a hydraulic cylinder containing a piston and piston cup. Some cylinders contain a check valve assembly at the hydraulic outlet for maintaining a slight amount of pressure (residual) in the hydraulic lines and wheel cylinders. The piston and piston cup are hollow and contain a check valve that allows brake fluid to pass through freely when the power cylinder is retracted. When the power cylinder extends, the check valve blocks the opening through the center of the slave cylinder piston. The slave cylinder then forces brake fluid under increased pressure to the wheel cylinders.

EXERCISE: Answer the following questions and check your responses against those listed at the end of this study unit.

1. In the 2-1/2 and 5-ton vehicle brake system, which component uses air to apply hydraulic fluid under increased pressure to the wheel cylinders?

   _____

2. What operates the control valve in the air hydraulic cylinder control unit?

   _____

3. What is the function of the slave unit?

   _____

4. List the three components of the air hydraulic cylinder.

   a. _____

   b. _____

   c. _____

Work Unit 3-3. HYDRAULICLY BOOSTED BRAKES

IDENTIFY THE TYPE OF POWER USED BY THE HYDRO-BOOST BRAKE SYSTEM ON THE CUCV.

IDENTIFY THE UNIT INCORPORATED IN THE HYDRO-BOOST UNIT WHICH PROVIDES A RESERVE POWER SUPPLY TO THE BOOSTER.

DESCRIBE BRIEFLY HOW THE HYDRAULIC PRESSURE IS DIVERTED TO THE THE POWER PISTON.

STATE THE PROCEDURE TO FOLLOW WHEN CHARGING THE HYDRO-BOOST ACCUMULATOR.

STATE WHAT YOU WOULD CONSIDER IF EITHER STEERING FLUID OR BRAKE FLUID LEAKED TO THE SEALS OF THE OTHER UNIT.

The CUCV uses a hydraulically assisted brake system to assist the operator in stopping the vehicle. The hydraulic brake system itself consists of a dual master cylinder, front disc calipers and rear drum shoes as described in Study Unit 1. In this study unit the hydraulic boost unit incorporated on the CUCV will be discussed. In this hydro-boost system the power steering pump provides the assistance necessary to ease the operator's effort when stopping the vehicle.

The hydro-boost unit (fig 3-3), like the vacuum booster, is mounted between the brake pedal and the master cylinder, but uses hydraulic pressure produced by the power steering pump. In the release position, fluid from the power steering pump flows through the open center valve of the hydro-boost unit to the steering gear power unit and back to the reservoir. When foot pressure on the brake pedal depresses the pedal rod, the outlet to the steering gear in the hydro-boost unit is closed and the hydraulic pressure is diverted to the power piston. The power piston then pushes the outlet rod into the master cylinder applying the brakes as described in study unit 1.

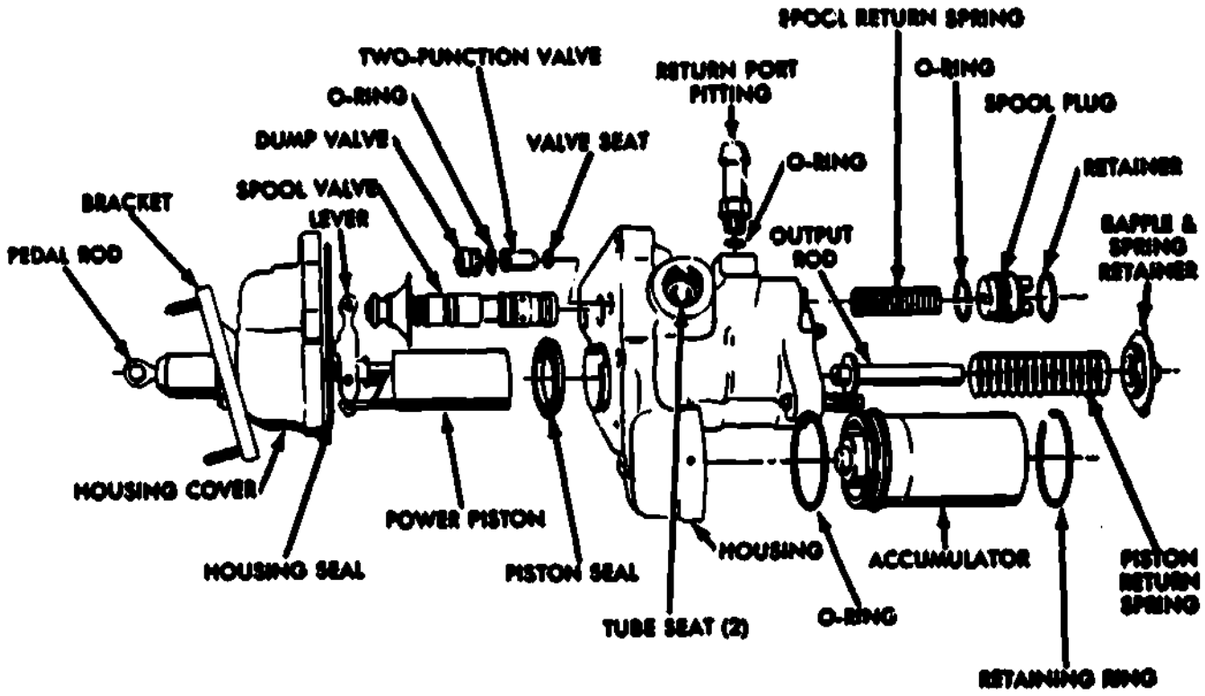


Fig 3-3. Typical hydro-boost unit.

As the hydraulic pressure in the boost pressure chamber moves the power piston toward the master cylinder, a lever moves the spool valve back to the release position which allows the pressure to be regulated by the force applied on the brake pedal.

Note: Brake fluid and power steering fluid must not be mixed. If steering fluid contacts brake seals or the opposite, seal damage will occur.

If the power steering pump fails to operate, a reserve system is incorporated to assist in applying the brakes. This reserve system or accumulator assembly store hydraulic pressure to be used if the hydraulic power steering system fails. The accumulator (fig 3-4) consists of a piston in a closed cylinder filled with nitrogen gas. When charged (AIV-2 Reserve System Check), the accumulator will have enough reserve pressure for one or two brake applications.

Caution: The accumulator contains compressed gas. Always follow the precedures in the technical manual to prevent personal injury. The accumulator must be replaced if it is found to be inoperative. Always drill a 1/16 inch diameter hole in the end of the accumulator opposite the "O" ring when it is found to be defective.

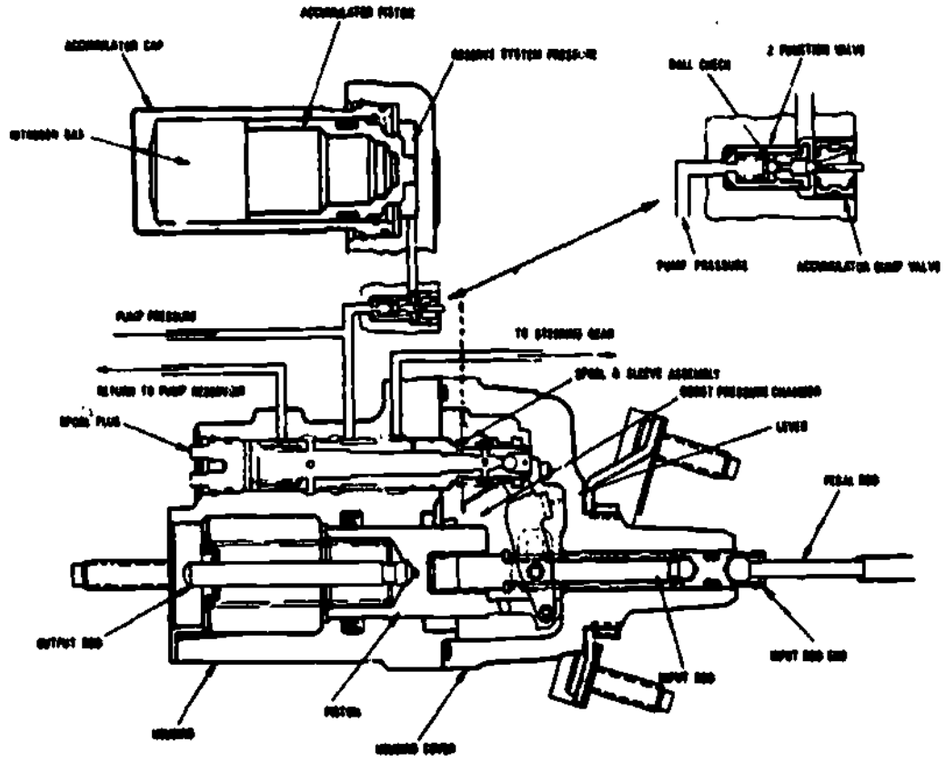


Fig 3-4. Hydro-boost unit (sectional view).

For troubleshooting procedures refer to appendix IV or the appropriate TM. Maintenance and repair criteria are contained in the appropriate technical manuals also.

EXERCISE: Answer the following questions and check your responses against those listed at the end of this study unit.

1. Identify the type of power used by the Hydr-Boost brake system on the CUCV.

   a. Vacuum from vacuum pump
   b. Water pressure from water pump
   c. Hydraulic pressure from power steering pump
   d. Air pressure from air compressor

2. Identify the unit incorporated in the hydro-boost unit which provides a reserve power supply to the booster.

   a. Two function valve
   b. Accumulator
   c. Power piston
   d. Power steering pump

3. Describe breifly how hydraulic pressure is diverted to the power piston.

   _____

   _____

4. State the procedure to follow when charging the hydro-boost accumulator.

   _____

   _____

5. While repairing the brakes on a CUCV, you noticed that some brake fluid had accumulated on the power booster seal. What should you consider?

_____

_____

SUMMARY REVIEW

In this study unit you were introduced to power brake systems. You learned the components which increase hydraulic pressure. You learned what operates the control valve and the function of the slave cylinder. Lastly, you learned the three components of the air hydraulic cylinder assembly. In the next study unit you will be introduced to the auxiliary brake systems.

Answers to Study Unit #3 Exercises

Work Unit 3-1.

1. Vacuum

2. To assist the operator in stopping the vehicle and to ease the pressure applied to the brake pedal

3 To change vacuum to mechanical force which assists the application of hydraulic brakes

4. a. Vacuum from the engine or vacuum pump

   b. Atmospheric pressure

5. The engine vacuum system

6. A loss of vacuum due to leaks

Work Unit 3-2.

1. Air hydraulic cylinder

2. Hydraulic pressure from the master cylinder

3. To force hydraulic fluid under increased pressure to the wheel cylinders

4. a. Control unit

   b. Power cylinder

   c. Slave cylinder

Work Unit 3-3.

1. c

2. b

3. The outlet to the steering gear in the hydro-boost unit is closed and pressurized fluid is directed to the power piston which applies the brake.

4. Start engine and either turn the steering wheel from stop to stop or apply the brake pedal with approximately 100 pounds of force.

5. Seal damage on both the master cylinder and booster unit.

STUDY UNIT 4

AUXILIARY BRAKE SYSTEMS

STUDY UNIT OBJECTIVE: WITHOUT THE AID OF REFERENCES, YOU WILL IDENTIFY THE PURPOSE OF AUXILIARY BRAKE SYSTEMS, THE METHOD OF APPLYING PARKING BRAKES, AND THE THREE TYPES OF PARKING BRAKES. YOU WILL ALSO IDENTIFY HOW TO RELEASE SPRING BRAKES. LASTLY, YOU WILL IDENTIFY THE FUNCTIONS OF THE COMPONENTS OF AUXILIARY BRAKE SYSTEMS.

Work Unit 4-1. INTRODUCTION

STATE THE PURPOSES OF AUXILIARY BRAKE SYSTEM.

LIST THE THREE MEANS OF EMERGENCY (PARKING) BRAKE ACTUATION.

The purpose of a brake system is to retard the speed or stop the vehicle. All vehicles have either a hydraulic or an air brake system. A hydraulic brake system can be assisted by a vacuum, air, or hydraulic power booster. In the event that the service brake system fails, an auxiliary means of applying brakes must be incorporated in a vehicle. Therefore, the purpose of an auxiliary braking system is to provide a means of stopping a vehicle when the service brake system fails and to hold the vehicle stationary. The auxiliary system is normally a mechanical linkage connected to an external contracting or an internal expanding assembly applying braking power to the drive shaft, or a system of cables and levers connected to the rear wheel brakes. Vehicles with air brakes have a spring actuating device incorporated in the combination brake chambers to apply stopping power when the air system fails. These systems will be discussed in this study unit. Essentially there are three means of actuating auxiliary brakes: (1) mechanical linkage to a brake on the drive shaft; (2) a cable and lever connected to the rear wheel brakes; and (3) spring pressure.

Note: All vehicles must have an auxiliary means of applying brakes. On vehicles with a hydraulic brake system, the parking brake is applied by mechanical means. Some vehicles which utilize an air brake system also have a mechanical parking brake on the drive line.

EXERCISE: Answer the following questions and check your responses against those listed at the end of this study unit.

1. State the purposes of an auxiliary brake system.

_____

2. List the three means of emergency (parking) brake actuation.

a. _____

b. _____

c. _____

Work Unit 4-2. PARKING BRAKES

STATE HOW A PARKING BRAKE IS APPLIED ON VEHICLES WITH HYDRAULIC BRAKES.

LIST THE THREE TYPES OF MECHANICAL PARKING BRAKES.

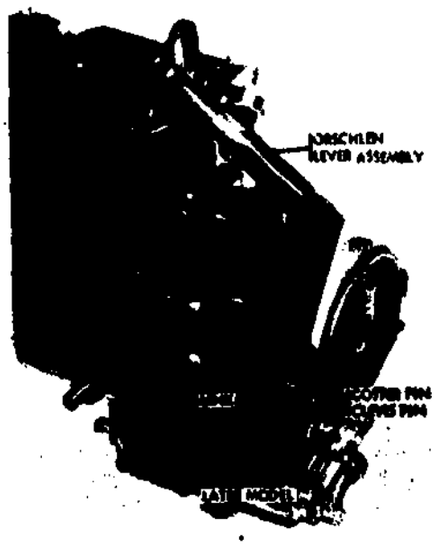
STATE THE LOCATION OF THE EXTERNAL CONTRACTING PARKING BRAKE AND HOW IT OPERATES.

STATE THE LOCATION OF THE INTERNAL EXPANDING PARKING BRAKE AND HOW IT OPERATES.

STATE THE OPERATION OF A PARKING BRAKE USING THE REAR WHEEL BRAKES.

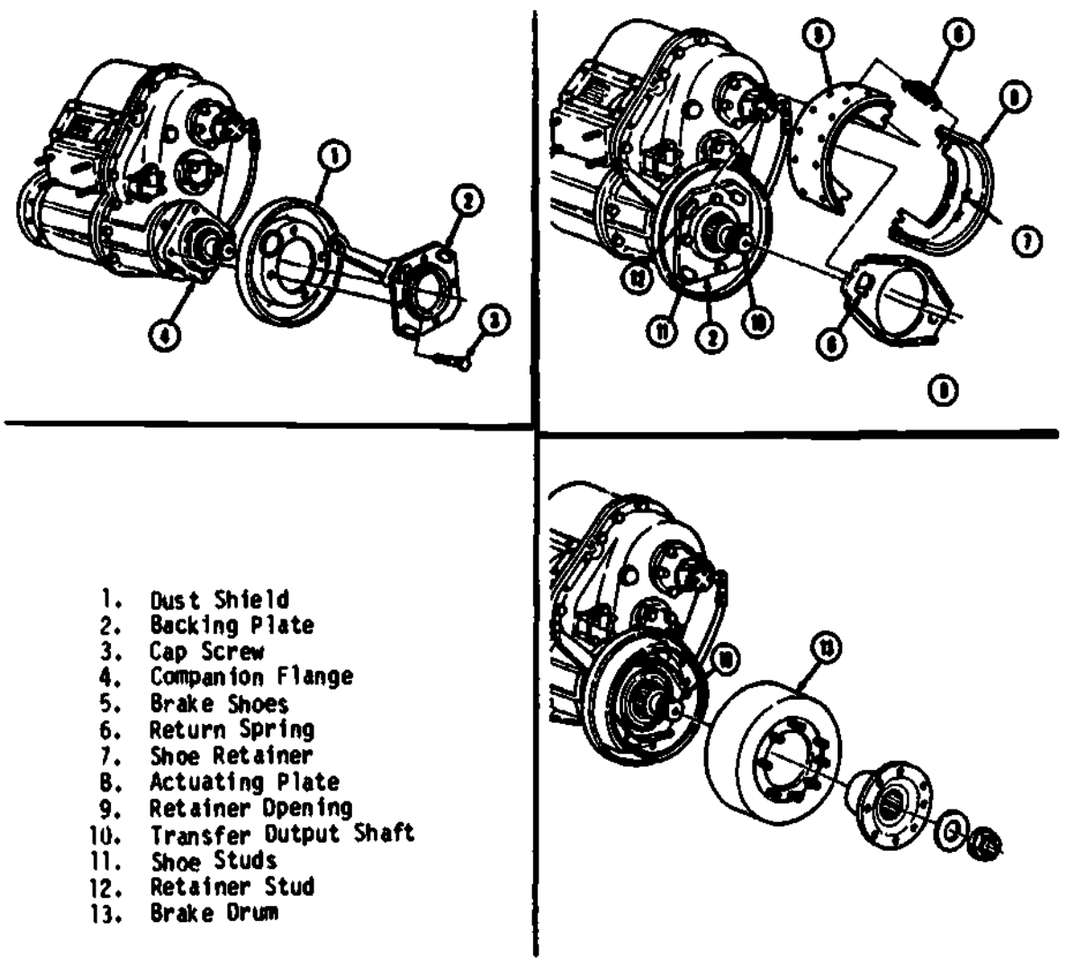
External Contracting Parking Brake (fig 4-1)

An external contracting parking brake consists of an operating lever, linkage, brake band, and brake drum. The operating lever normally has a rotary adjustment feature with which the operator can make a minor adjustment when the brake fails to hold. The brake band is anchored to the transmission case while the brake drum is mounted to the transmission output shaft. Linkage from the operating lever to the brake band allows force to be transferred mechanically to the parking brake.



Internal Expanding Parking Brake (fig 4-2)

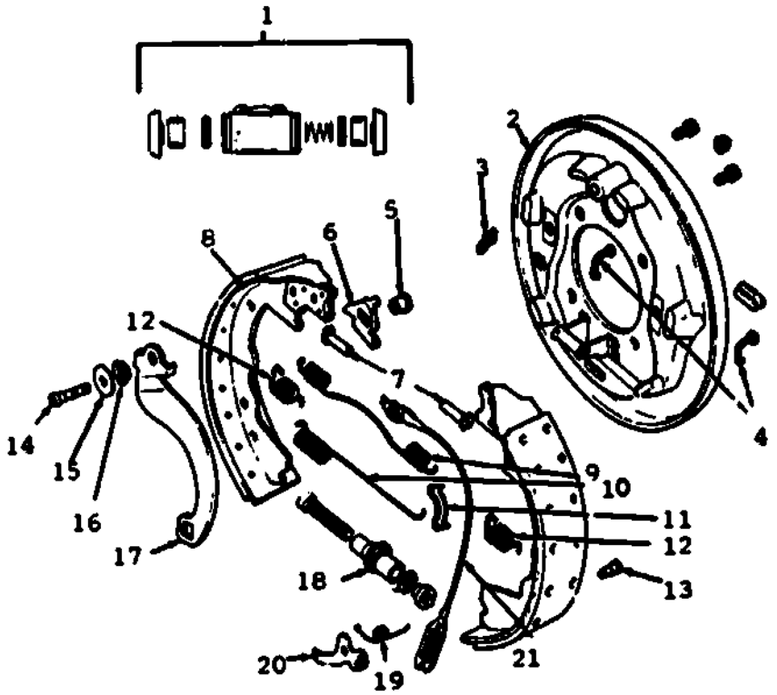
The internal expanding parking brake is similar in appearance to a wheel service brake assembly except that the parking brake is mechanically actuated. The parking brake consists of two brake shoes which expand to make contact with a brake drum mounted on the transfer output shaft. A cam and lever expand the shoes when the operator moves the parking brake lever. A cable assembly transfers the motion of the actuating lever to a cam and lever in the brake assembly.



1. Dust Shield
2. Backing Plate
3. Cap Screw
4. Companion Flange
5. Brake Shoes
6. Return Spring
7. Shoe Retainer
8. Actuating Plate
9. Retainer Opening
10. Transfer Output Shaft
11. Shoe Studs
12. Retainer Stud
13. Brake Drum

Fig 4-2. Internal expanding parking brake (M939).

The M880 parking brake uses the rear wheel brakes to hold the vehicle stationary. This system uses a foot pedal which pulls a cable that is connected to a lever in the rear wheel brake assembly. The lever motion is transferred to a parking brake anchor plate which forces the brake shoes outward to contact the brake drum (fig 4-3). In some vehicles, the lever is connected to a brake shoe and uses a link to spread the brake shoes. In both cases, the parking brake uses the rear wheel brake shoes to prevent movement of the vehicle.



1. Wheel Cylinder
2. Backing Plate
3. Bleeder Screw
4. Pin, Shoe Holddown
5. Bushing
6. Anchor Plate, Parking Brake
7. Rod, Push
8. Brake Shoe
9. Spring Shoe Return, Upper
10. Spring Shoe Return, Lower
11. Guide, Automatic Adjuster
12. Spring, Shoe Holddown
13. Pin, Pivot
14. Bolt, Parking Brake Lever
15. Washer
16. Spring
17. Lever, Parking Brake
18. Brake Adjusting Screw
19. Spring, Aitomatic Adjuster
20. Lever, Automatic Adjuster
21. Cable, Automatic Adjuster

Fig 4-3. Rear wheel brake assembly (M880).

EXERCISE: Answer the following questions and check your responses against those listed at the end of this study unit.

1. By what method is a parking brake applied on vehicles with hydraulic brakes?

   _____

2. What are the three types of mechanical parking brakes?

   a. _____

   b. _____

   c. _____

3. Where is the external contracting parking brake located?

   _____

4. How does the external contracting brake operate?

_____

5. Where is the internal expanding parking brake located?

_____

6. How does the internal expanding parking brake operate on the transfer output shaft?

_____

7. How does the foot lever engage the rear wheel brakes on the M880?

_____

Work Unit 4-3. SPRING BRAKE

STATE HOW THE FAIL-SAFE UNIT CONTAINED IN THE COMBINATION BRAKE CHAMBER APPLIES THE BRAKE WHEN THE AIR PRESSURE IS NOT ABOVE 55 PSI.

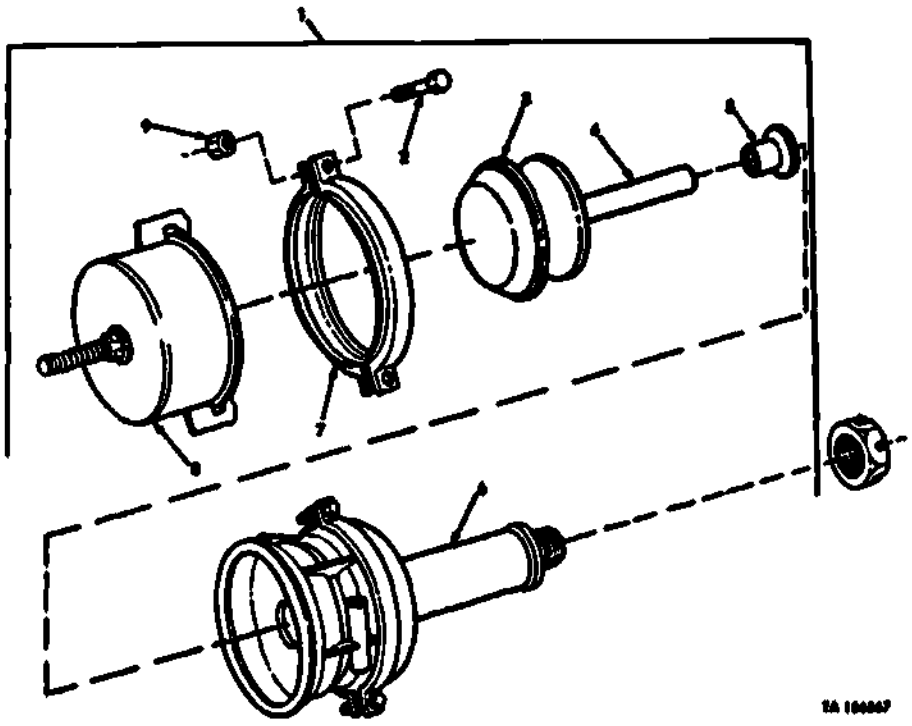
STATE WHEN THE FAIL-SAFE UNIT APPLIES THE BRAKES.

LIST TWO WAYS THE FAIL-SAFE UNIT MAY BE RELEASED.

STATE THE FUNCTION OF THE AIR BRAKE SPRING BRAKE RELEASE VALVE.

STATE THE FUNCTION OF THE PARKING BRAKE RELEASE VALVE.

The M939 series vehicles use a fail-safe brake chamber (fig 4-4) on the rear wheels. On this unit, the brakes on the rear wheels are applied when air pressure in the primary supply system is below 55 psi or when the parking brake is applied. If the pressure in the air supply system has not reached or falls below 55 psi, spring pressure will apply the rear brakes. Therefore, the fail-safe unit insures that the vehicle does not move when there is low air pressure.



1. Failsafe brake chamber
2. Bolt
3. Diaphram
4. Push Rod
5. Guide
6. Housing, Non Pressure
7. Clamp
8. Housing, Failsafe Brake
9. Nut

Fig 4-4. Fail-safe brake chamber.

Caution: DO NOT disassemble fail safe unit (spring brake) without caging spring assembly.

Since spring pressure applies the brakes when air pressure is low, air pressure releases the brakes. The release of the fail-safe unit may be accomplished in two ways: when the parking brake is released or when the spring brake release control valve (fig 4-5) is activated. When the parking brake is applied, a valve vents air pressure in the fail-safe unit to the atmosphere. This applies the rear wheel brake. Upon release of the parking brake, air is directed to the fail-safe unit, releasing the spring brake. Spring brakes can be released independently of the hand brake by activating the spring brake release control on the dash board. This is to check the adjustment of the mechanical parking brake. When normal air pressure is obtained, the spring brake release valve must be activated, before the vehicle can be moved. Activating the spring brake release valve allows air from the supply system to enter the fail-safe unit to release the brakes.

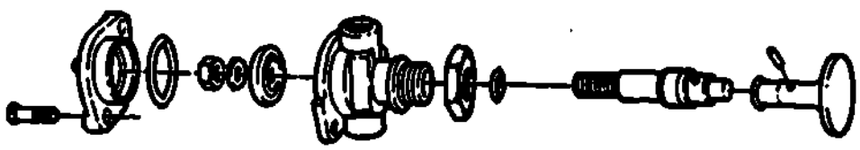


Fig 4-5. Spring brake release control valve (exploded).

EXERCISE: Answer the following questions and check your responses against those listed at the end of this study unit.

1. When the air pressure in the air brake system has not reached the operational pressure or falls below 55 psi, what keeps the fail-safe brakes applied?

   _____

2. When does the fail-safe unit apply the brakes?

   a. _____

   b. _____

3. What are two ways a fail-safe unit may be released?

   a. _____

   b. _____

4. What is the function of the following valves?

   a. Air brake spring release valve: _____

   _____

   b. Parking brake release valve: _____

   _____

SUMMARY REVIEW

In this work unit you learned how parking brakes are applied, the three types of parking brakes, the location and operation of the external contracting parking brake, the location and operation of the internal expanding parking brake, and the operation of a parking brake using the rear wheel brakes.

Answers to Study Unit #4 Exercises

Work Unit 4-1.

1. To provide an auxiliary method of stopping a vehicle when the service brake fails and to hold the vehicle stationary

2. a. Mechanical linkage to a brake on the drive shaft

   b. Cable and lever connected to the rear wheel brakes

   c. Spring pressure in the fail-safe unit of the combination air brake chamber

Work Unit 4-2.

1. Mechanical

2. a. External contracting

   b. Internal expanding

   c. Cable actuating the rear wheel brakes

3. In the transmission output shaft

4. By a rod and lever applying force to a co :racting brake band against brake drum

5. On the transfer output shaft

6. By a cable pulling a lever and cam which expands the brake shoes

7. By a cable pulling the parking brake lever attached to the rear service brake shoes

Work Unit 4-3.

1. Spring pr :ssure

2. a. When air pressure is below 55 psi

   b. When parking brake is applied

3. a By activating spring brake release valve to route air to fail-safe chamber

   b. By releasing the parking brake

4. a. Routes air pressure to the fail-safe unit

   b. Vents air pressure from the fail-safe unit

APPENDIX I

TROUBLESHOOTING HYDRAULIC BRAKE SYSTEMS

CONDITION	CAUSE	REMEDY
Excessive pedal travel	1. Low fluid level in master cylinder.	1. Fill master cylinder.
	2. Air in system.	2. Bleed hydraulic system.
	3. Excessive brake shoe to drum clearance.	3. Adjust brake shoes.
Fading brake pedal (pedal falls away under steady pressure)	1. Leak in hydraulic system.	1. Fill master cylinder and look for leaks in the lines, wheel cylinders, or master cylinder; repair as required
	2. Defective master cylinder primary cup.	2. Repair or replace as necessary
Spongy brake pedal (soft or springy when applied)	1. Air in hydraulic system.	1. Bleed brakes.
Grabbing brakes	1. Grease, brake fluid or water on brake lining	1. Replace or allow to dry as necessary.
	2. Incorrect or loose lining on brake shoes.	2. Replace as necessary.
	3. Wheel cylinder sticking or frozen.	3. Repair or replace as necessary.
	4. Restricted brake line.	4. Remove restriction or replace line.
Pulsating brake pedal	1. Drums out of round	1. Machine or replace drums.
	2. Rotors bent or uneven	2. Repair or replace rotor.
	3. Front wheel bearing loose	3. Adjust wheel bearing.
Noisy brakes	1. Lining worn out	1. Replace brake linings.
	2. Broken or weak return or hold-down spring.	2. Replace spring.
	3. Foreign material in brake drum.	3. Clean or replace as necessary.
	4. Grooved or scored drum(s) or rotor(s).	4. Replace or turn as necessary.

APPENDIX II

TROUBLESHOOTING AIR BRAKE SYSTEMS

CONDITION	CAUSE	REMEDY
Uneven braking or lining wear	1. Ruptured diaphragm.	1. Repair or replace brake chamber as necessary.
	2. Wedge rod misalined.	2. Realine or repair wedge assembly.
	3. Corroded or frozen plunger.	3. Repair plunger as necessary.
	4. Incorrect adjustment.	4. Adjust brake shoes.
	5. Grease on lining or glazed lining.	5. Replace brake shoes.
	6. Shoes installed backwards.	6. Reinstall brake shoes correctly.
Brakes do not apply or apply poorly	1. Low air pressure.	1. Check air compressor operation and repair as necessary.
	2. Leaks in air system or components.	2. Locate source of leak(s); repair or replace as necessary.
	3. Improper brake shoe clearance.	3. Adjust brake shoes.
Fail-safe unit not holding.	1. Power spring not fully released	1. Uncage fail-safe unit.
	2. Power spring broker.	2. Replace power spring or fail-safe unit as required.
	3. Incorrect brake adjustment.	3. Adjust brakes.
	4. Hold off air not releasing.	4. Repair or replace spring air release valve.
Brake dragging	1. Low air pressure.	1. Check air system operations and repair as necessary.
	2. Leaking air lines or fail-safe seals.	2. Repair leaks as necessary.

APPENDIX III

BLEEDING HYDRAULIC BRAKE SYSTEMS

MANUAL BLEEDING

Fill master cylinder. Place bleeder hose on first wheel cylinder to be bled (See bleeding sequence). Place other end of the hose in clean container. Have helper depress brake pedal to floor and hold. Open bleeder valve. While pedal is depressed close bleeder valve. Release pedal and repeat procedure until flow of fluid shows no signs of air bubbles. Bleed remaining cylinders in sequence and in same manner.

PRESSURE TANK METHOD

Remove cap from master cylinder and install adapter and pressure hose from pressure tank (bleeder ball). Insure that the tank is at least 1/3 full of fluid. The pressure in the tank should not exceed 35 psi. Install bleeder hose on first bleeder valve (See bleeding sequence) insuring that other end of hose is in a clean container. Open bleeder valve and observe fluid. When no air bubbles are present, close bleeder valve. Bleed remaining cylinders in correct sequence and in the same manner.

BLEEDING SEQUENCE

1. Master Cylinder (if equipped with bleeder valve).
2. Air hydraulic cylinder (if vehicle is equipped with air assisted hydraulic brakes).
3. Wheel cylinders in the following sequence: right rear. left rear, right front, left front

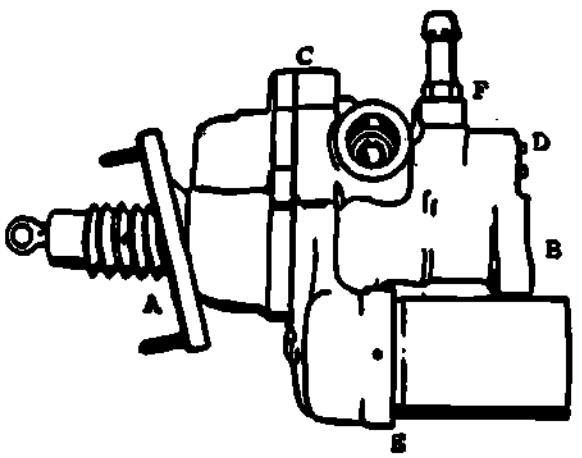
APPENDIX IV

HYDRO-BOOST DIAGNOSIS

Note: Power steering fluid and brake fluid cannot be mixed. If steering seals contact brake fluid or vica versa the seals maybe considered damaged.

Check the following items prior to diagnosing problems with the hydro-boost unit.

1. All power steering and brake lines for leaks.
2. Fluid level in the power steering reservoir and brake fluid in the master cylinder.
3. Power steering pump belt tension and wear.
4. Engine idle speed.
5. Power steering pump pressure.



HYDRO-BOOST UNIT LEAKAGE

A. INPUT SEAL LEAK - Fluid leakage from housing cover end of booster near reaction bore.

B. PISTON SEAL LEAK - Fluid leakage from vent at front of unit master cylinder.

C. HOUSING - Fluid leakage between the housing and housing cover.

D. SPOOL VALVE SEAL - Fluid leakage near plug area.

E. ACCUMULATOR CAP SEAL - Fluid leakage from accumulator area.

F. RETURN PORT FITTING SEAL.

NOISES

1. Low frequency hum usually accompanied by vibration in brake pedal and/or steering wheel while parking.

    a. Check fluid level in power steering reservoir.

    b. If condition continues check power steering pump for wear.

2. High speed fluid noise at or near fully depressed brake pedal.

    a. Normal condition.

    b. Will not be heard except when stopped with brake pedal fully depressed or during emergency stops.

3. Hiss when accumulator pressure is used is normal.

4. Hissing after accumulator has been empied and the engine is started is normal during first brake application or steering maneuver. If the hissing continues after charging the accumulator perform a "accumulator leakdown test."

RESERVE SYSTEM CHECK

1. Start engine and apply the brake pedal with approximately 100 lbs force or turn steering wheel from stop to stop to charge accumulator.

2. Turn off engine and wait one hour.

3. After one hour wait, apply brake pedal with engine off. Reserve System (accumulator) should have two power assist applications.

BOOSTER FUNCTION CHECK

1. Apply brake pedal several times with engine off until accumulator is completely depleted.
2. Apply brake (approximately 40 pounds of force) and start engine.
3. Pedal should fall and then rise against drivers foot.

AUTOMOTIVE BRAKE SYSTEMS

Review Lesson

Instructions: This review lesson is designed to assist you in preparing for your final exam. You should try to complete this lesson without the aid of reference materials, but if you do not know an answer, look it up and remember what it is. The enclosed answer sheet must be filled out according to the instructions on the reverse side and mailed to MCI using the envelope provided. The questions you miss will be listed with references on a feedback sheet (MCI-R69) which will be mailed to your commanding officer with your final exam. You should study the reference material for the questions you missed before taking the final exam.

A. Multiple Choice: Select the ONE answer that BEST completes the statement or answers the question. After the corresponding number on the answer sheet, blacken the appropriate circle.

Value: 1 point each

1. By what means does a brake systems retard the motion of a vehicle?

   a. Friction
   b. Hydraulically
   c. Air
   d. Air resistance

2. A rotating brake surface coming in contact with a non-rotating surface produces

   a. kinetic energy.
   b. static energy.
   c. hydraulic pressure.
   d. friction.

3. In a brake unit, two types of surfaces (in relation to motion) are evident, They are _____ surfaces.

   a. static and dynamic
   b. rotating and non-rotating
   c. rotating and moving
   d. stationary and not moving

4. Brake systems are designed to be efficient due to the requirement that a vehicle must able to

   a. accelerate at a fast rate.
   b. decelerate at a faster rate than or can accelerate.
   c. decelerate slower than it can accelerate.
   d. decelerate at the same rate of acceleration.

5. The hydraulic brake system eliminates

   a. rotating and non-rotating surfaces.
   b. wheel cylinders.
   c. rods, gears, and levers
   d. friction,

6. In a hydraulic brake system, the transmission of hydraulic _____ and _____ are equal.

   a. pressure, motion
   b. liquid, force
   c. force, pressure
   d. motion, movement

7. Stopping force is one requirement of a brake system. A hydraulic brake system has an advantage of _____ force in relation to the size of the pistons.

   a. decreasing
   b. moving
   c. multiplying
   d. stopping

8. A liquid is not subjected to _____ or _____.

   a. breakage, wear
   b. breakage, vibration
   c. wear, heat
   d. breakage, freezing

9. Pascal's Law of hydraulics states that any force applied to a liquid is transmitted

   a. in the container.
   b. only on the surface of the liquid.
   c. equally in all directions throughout the liquid.
   d. equally, depending upon the size of the output.

10. With a hydraulic system, force can be increased if the _____ piston is larger than the _____ piston.

a. input, output
b. output, input
c. primary, secondary
d. wheel cylinder, master cylinder

11. Hydraulic fluid must not _____ or _____ metal or rubber parts.

a. deteriorate, corrode
b. rust soften
c. rust, harden
d. corrode, rust

12. Hydraulic fluid must have a _____ boiling point and a _____ freezing point.

a. low, high
b. moderately high, low
c. high, low
d. very low, high

13. Hydraulic fluid must also have characteristics which allow for _____ and _____.

a. self-lubrication, evaporation
b. slow evaporation, absorbtion of water
c. self-lubrication, hydraulic pressure
d. self-lubrication, slow evaporation

14. Master cylinders can be made of aluminum or

a. cast iron.
b. steel.
c. bronze.
d. tin.

15. Why are there two brake systems in a dual master cylinder?

a. To allow the vehicle to be stopped if one system fails
b. To reduce the problem of not enough fluid
c. To eliminate bleeding air from the system

16. Hydraulic brake lines are made of high quality double thickness

a. copper tube.
b. steel tube.
c. nylon tube.
d. rubber tube.

17. To change hydraulic pressure to mechanical force is the purpose of the

a. master cylinder.
b. proportioning valve.
c. metering valve.
d. wheel cylinder.

18. When air enters the hydraulic brake system you must

a. bleed the brake system.
b. open the bleeder valve.
c. open the check valve.
d. repair the master cylinder.

19. The primary shoe faces to the _____ of the vehicle.

a. rear
b. center
c. front
d. top

20. Brake lining may be riveted or _____ to the shoe.

a. welded
b. bonded
c. bolted
d. screwed

21. Brake drums are most commonly of _____ construction.

a. pressed steel
b. cast iron
c. aluminum
d. centrifuse

22. A combination of a pressed steel center with a cast iron braking surface is called a(n) _____ brake drum.

a. combination
b. centrifuse
c. self-cooling
d. expanding

23. The tendency of the brake shoes to rotate with the brake drum is called

a. servo application.
b. self determination.
c. self energization.
d. self turning.

24. Ensuring that the rear drum brake is applied at about the same time as the front disc brake is the purpose of a(n)

a. metering valve.
b. proportioning valve.
c. check valve.
d. combination valve.

25. To prevent rear wheel locking during rapid stopping a _____ is incorporated in the brake system.

a. metering valve
b. proportioning valve
c. combination valve
d. bleeder valve

26. When the brake pedal is released, the disc brakes are, in turn, released by

a. action of a return spring.
b. reverse pressure.
c. action of the caliper seal.
d. action of the rotor.

27. Air, when compressed, has the properties of a(n) _____ when used in a brake system.

a. semi-solid
b. gas
c. solid
d. liquid

28. The air pressure entering a brake chamber and the surface area of the diaphram equals the

a. force obtained.
b. force needed.
c. force expended.
d. potential force.

29. Which of the following components provides compressed air for use in an air brake system and other air operated components?

a. Governor
b. Reservoir
c. Air compressor
d. Air brake chamber

30. Controlling the air pressure in the primary reservoir is the purpose of

a. unloading valve.
b. pressure gage.
c. governor.
d. warning buzzer.

31. The air compressor will not compress air when the _____ is activated.

a. unloader valve
b. treadle valve
c. governor valve
d. limiting valve

32. The air supply in an air brake system is stored in which component?

a. air compressor
b. reservoir
c. treadle valve
d. supply system

33. Which of the following insures that excessive pressure is not obtained in the air system?

a. Warning buzzer
b. governor
c. Tractor protection valve
d. Pressure relief valve

34. Since water will contaminate an air brake system, which component is used to eliminate accumulated condensation from the air supply system?

a. Alcohol evaporator
b. Check valve
c. Drain cock
d. Primary reservoir

35. Air pressure moves to the various components through which of the following?

a. Relay valve
b. Check vale
c. Nylon or copper tubing
d. Supply system

36. How would a malfunctioning air governor be detected?

a. By monitoring the air pressure gage
b. The brake pedal would go to the floor
c. The vehicle would not stop
d. The low pressure warning buzzer would be activated

37. What would the sound of the warning buzzer indicate to you?

a. Excessive pressure in the air system
b. A malfunctioning air governor
c. That existing air pressure in the air system is too low
d. A malfunctioning unloader assembly

38. The pressure in the air system on M939 series vehicles is regulated at _____ to _____ pounds per square inch.

a. 65 - 100
b. 70 - 150
c. 70 - 127
d. 90-120

39. Air brakes, when applied, allow for control of air pressure to the brake chambers at the proper time. This accomplished by which system/component?

a. Air control system
b. Air supply system
c. Air brake vent system
d. Relay valve

40. The application of air pressure to the rear wheel brakes on tandum axle vehicles is controlled by which component?

a. Air brake control system
b. Relay valve
c. Double check valve
d. Limiting valve

41. The rear brakes of a vehicle must be engaged before the front brakes or at the same time. Which component of the air brake system insures that this happens?

a. Front Limiting valve
b. Treadle valve
c. Double check valve
d. Hand control valve

42 The application of brakes only on a towed vehicle is the function of which component?

a. Treadle valve
b. Relay valve
c. Hand control valve
d. Double check valve

43. Which component prevents air pressure from reversing its direction to the air compressor?

a. Double check valve
b. Single check valve
c. Tractor protection valve
d. Safety valve

44. Which component allows application of air from two sources (towed vehicle brakes)?

a. Treadle valve
b. Relay valve
c. Single check valve
d. Double check valve

45. Routing of air after the release of the brakes is accomplished by the

a. treadle valve.
b. air brake control system.
c. air brake vent system.
d. relay valve.

46. The stopmaster brake system on the M939 uses which type of activation?

a. Cam and lever
b. Wedge
c. Hydraulic wheel cylinder
d. Caliper

47. Preventing damage to brake components is accomplished by

a. using a caliper assembly.
b. using the cam and lever system.
c. indexing the spider assembly.
d. using the stop master (wedge) system.

48. Which component applies force to the brake shoes to stop the vehicle when the treadle valve is depressed?

a. Fail-safe unit of the combination brake chamber
b. Service brake chamber
c. Treadle valve
d. Relay valve

49. Which component contains a diaphragm and rod assembly and a spring activation assembly in the same unit?

a. Service brake chamber
b. Wedge assembly
c. Combination brake chamber
d. Spider assembly

50. The function of a combination brake chamber is which of the following?

a. To apply force to the brake shoes
b. To provice alternate method of applying force to the brake shoes
c. To apply force to the brake shoes on the trailer
d. To apply force to the brake shoes and provide an alternate method of applying brakes

51. What is the function of the wedge in the M939 air brake system?

a. To insure proper application of brakes
b. To transfer lineal force from the brake chamber to the plungers which transfers force to the brake shoes
c. To change air pressure to mechanical force
d. To release the brakes upon removal of air pressure

52. The plungers contained in the spider assembly provide a means of self adjustment and

a. transmit force from the wedge to the brake shoes.
b. release the force applied by the brake shoes.
c. apply force to the wedge assembly.
d. anchor the brake shoe to the spider.

53. When are brake chambers adjusted with the stop master brake system?

a. Upon replacement of the brake shoes
b. Upon replacement of the brake chamber
c. No adjustment is necessary
d. When the brake chamber has been rebuilt

54. When would you adjust the clearance between the brake shoe and brake drum on the M939 Series Vehicles?

a. When there is lining wear
b. Normally, only upon replacement of the brake shoes
c. No adjustment is ever necessary
d. After excessive braking

55. There is another type of brake system on military vehicles which uses a cam and lever. The purpose of the cam to

a. apply force to the brake shoes.
b. transfer motion produced by the relay chamber.
c. transmit lineal force to the plungers.
d. produce drag on the brake drum.

56. The function of the lever in a cam and lever assembly brake system is to transfer the motion of the brake chamber to the cam and to

a. provide added force by self energizing action.
b. provide method of adjustment compensating for lining wear.
c. provide a link between the brake chamber and the wedge.
d. assist in the release of the brake shoes.

57. Stop master brake systems have self adjusters to compensate for lining wear. Where is this adjustment made on the cam and lever system?

a. Cam
b. Brake chamber rod
c. Brake shoe eccentries
d. Slack adjusting screw on the lever

58. Light vehicles, such as the M880, have power assisted brakes. What type of power is used to assist this braking system?

a. Air power
b. Hydraulic power
c. Vacuum power
d. Air hydraulic power

59. Power brake systems are designed to assist in stopping the vehicle. They are also responsible for

a. easing braking action at the brake shoes.
b. easing brake pedal pressure.
c. enabling the vehicle to stop in a shorter distance.
d. decreasing hydraulic pressure in the master cylinder due to the added braking power.

60. Which of the following components produce the force which increases the hydraulic pressure on the M880?

a. Vacuum Power unit
b. Hydraulic master cylinder
c. Power steering pump
d. Air compressor

61. The operation of a vacuum power unit uses vacuum from the engine or vacuum pump. What other force is controlled within the vacuum power unit?

a. Hydraulic pressure
b. Atmospheric pressure
c. Hydrostatic pressure
d. Air pressure

62. What would be the most probable cause if excessive foot pressure is required to stop a vehicle with a vacuum assist power brake system?

a. A leak in a brake line
b. Excessive vacuum produced by the engine or vacuum pump
c. Leaks in the engine vacuum system
d. Leaks in the hydraulic system

63. What force is used to increase hydraulic pressure to the wheel cylinder on military 2 1/2 and 5 ton vehicles?

a. Vacuum
b. Hydraulic
c. Atmospheric pressure
d. Air pressure

64. What activates the control unit of the air hydraulic cylinder?

a. Air pressure
b. Hydraulic pressure from the master cylinder
c. Hydraulic pressure from the power steering pump
d. Vacuum pressure produced by the engine

65. As air is allowed to enter to the power unit of the air hydraulic cylinder, where is the hydraulic pressure increased to the wheel cylinders?

a. In the master cylinder
b. At the wheel cylinders
c. In the hydraulic pump
d. In the slave cylinder

66. The three components of an air hydraulic cylinder are the control unit, power cylinder, and

a. master cylinder.
b. hydraulic cylinder.
c. slave cylinder.
d. air compressor.

67. What type of power is used on the M1008 (CUCV) power assist unit of the power brake system?

a. Vacuum
b. Air
c. Electric
d. Hydraulic

68. Which of the following is incorporated in the hydro-boost unit on the CUCV to provide a reserve power supply?

a. Power piston
b. Two function valve
c. Accumulator
d. Power steering pump

69. Power steering fluid flows from the pump to the hydro-boost unit and then to the steering gear. How is this hydraulic power diverted to assist in applying the brakes on the CUCV?

a. The center valve closes the outlet to the steering gear.
b. The input rod closes the inlet to the steering gear.
c. The movement of the brake pedal opens the outlet of the power steering pump.
d. The power piston opens a valve which allows steering fluid to enter the boost pressure chamber.

70. To charge the accumulator you would apply the brakes with approximately 100 pounds of pressure or which of the following?

a. Apply air pressure to the accumulator fitting.
b. Turn the wheels from stop to stop with the engine running.
c. Charge the accumulator prior to installing the hydro-boost unit with air pressure.
d. The accumulator must be charged by application of nitrogen under pressure regulated by special apparatus.

71. While repairing the brakes on a M1008 (CUCV) you notice that power steering fluid is in the secondary cap of the master cylinder. What must you consider?

a. That seal damage has occured in both the master cylinder and hydro-boost.
b. That the seal in the master cylinder is not damaged.
c. That only the hydro-boost seal is defective.
d. That the power steering pump is producing too much pressure.

72. What is a function of an auxiliary brake system?

a. To provide a second power brake system
b. To provide an auxiliary method of stopping a vehicle when the service brake system fails and to hold the vehicle stationary
c. To allow the operator to combine the service brakes and auxiliary brakes when hauling heavy loads
d. To only hold the vehicle stationary

73. The three means of applying emergency (parking) brakes are by mechanical linkage to a brake on the drive shaft, cable and lever connected the rear wheel brake, and

a. air pressure in the fail-safe unit of the combination brake chamber.
b. spring pressure in the fail-safe unit.
c. internal expanding brake assembly on the drive shaft.
d. external contracting on the rear axle.

74. How is the parking (emergency) brake applied on vehicles with hydraulic brakes?

a. Mechanically
b. Hydraulicly
c. By air pressure
d. By an external contracting lever

75. The three types of mechanical parking brakes on vehicles with hydraulic system are external contracting or internal contracting on the drive shaft and

a. a combination brake chamber.
b. air pressure activating an internal expanding brake assembly on the drive shaft.
c. a dual master cylinder.
d. a cable activating the rear wheel brakes.

76. The external contracting and the internal expanding parking brake which is normally operated by mechanical linkage or a cable, is mounted on the

a. rear wheel.
b. front axle propeller shaft.
c. transmission input shaft.
d. transmission or transfer output shaft.

77. What type of force applies the fail-safe brakes when the vehicle is parked or air pressure is not within the operating limits?

a. Mechanical linkage
b. Spring pressure
c. Cable and lever assembly
d. Cable connected to a cam and lever

78. The fail-safe spring brake is activated (applied) on M939 series vehicles when the air pressure is below operating limits or when the

a. the air pressure is above 120 psc.
b. the service brake application valve is pressed.
c. parking brake is applied.
d. the hand control valve is activated.

79. The fail-safe brake may be released when the spring brake release valve is activated and which of the following?

a. When the treadle valve is released.
b. When the parking brake is released.
c. When the hand control valve is released.
d. When the spring unit of the fail-safe unit is engaged.

Total Points: 79

* * *

T&E-1

STUDENT COURSE CONTENT ASSISTANCE REQUEST

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1. Use this form for any questions you may have about the course. Write out your question and refer to the study unit, work unit, or study question with which you are having problems. Complete the self-addressed block on the reverse side. Before mailing, fold the form and staple it so that MCI's address is showing. Additional sheets may be attached to this side of the form.

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COURSE IMPROVEMENT SURVEY

The Marine Corps Institute would appreciate your help in improving the course you have just completed. If you would take a few minutes to complete the following survey, we would have valuable information to help us improve this course. Your answers will be kept confidential and will in no way affect your grade.

Course Number [ ] Rank_____ MOS_____

Name (Optional) _____

Military Address (Optional) _____

1. Did you find inaccurate or outdated information in this course? ☐ Yes ☐ No

   List the areas you found inaccurate or out of date. Give page or paragraph if possible.

   _____
   _____
   _____

2. How long did it take you to finish the course?

   ☐ 1-5 hours ☐ 11-15 hours ☐ More than 20 hours
   ☐ 6-10 hours ☐ 16-20 hours

3. Were the procedures taught in this course understandable and useful? ☐ Yes ☐ No

   If "No," how could they be improved? _____

   _____

4. How much of the material taught in this course can you apply to your job?

   ☐ Almost all ☐ Very little ☐ None
   ☐ More than half ☐ Less than half

5. Did you have trouble reading or understanding the material in this course? ☐ Yes ☐ No

   If "Yes," explain_____

6. Were the illustrations in this course helpful? ☐ Yes ☐ No

   If "No," how could they be improved?_____

7. Put an "X" in a box on the scale below to show how well you feel the lessons and the course materials prepared you for the final examination. (On this scale "10" indicates that the material prepared you very well, a "5" indicates adequate preparation, and a "1" indicates very poor preparation.)

Very Poor				Adequate					Very Well
1	2	3	4	5	6	7	8	9	10

8. If you asked MCI for help, were the answers to your questions helpful?

   ☐ Yes ☐ No ☐ No questions sent to MCI

9. Please list below any suggestions you may have to improve this course. Try to be specific; give page or paragraph numbers. (You may also use the space on the back or attach additional sheets.)

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