SAFETY ISSUES ASSOCIATED WITH LOW PRESSURE INGROUND AUTOMOTIVE LIFTS

Introduction

An auto lift is a necessary tool in any automotive repair shop, whether the shop is a one-bay family business or a 30-bay shop in an auto dealership. Unfortunately, an auto lift can be a very dangerous tool because it is used to support a massive load above a work area. There are several common types of auto lifts used in repair shops: inground one and two post lifts, above ground two post lifts, and above ground four post lifts. Other variations are not as common in the United States but include side lifts and scissor lifts. Inground lifts can be further divided into low pressure lifts and high pressure lifts. These terms describe the fluid pressure levels used to extend the lift. This article is written about inground low pressure lifts.

Description of Lift

The advantages of an inground lift (and, especially a one post inground lift) are that it takes up very little space in the shop and it does not interfere with the mechanic's ability to open the doors of the vehicle being lifted. This means that, in a small repair shop, the mechanic has more room to move around the vehicle when the lift is employed, and he has more work space in the shop when the inground lift is retracted to its stored position in the shop floor. In a large shop such as those in automotive dealerships, using inground lifts means that the dealer has room for more lifts and is able to increase his throughput of repairs, thus enhancing the profitability of his service business.

A low pressure lift is powered by the compressed air system in the shop, whereas a high pressure lift employs a dedicated hydraulic pump which provides high pressure hydraulic fluid to a hydraulic cylinder to raise the lift. The advantages of a low pressure lift over a high pressure lift are that the low pressure lift has fewer moving parts and it does not require a dedicated hydraulic system (pump, hoses, and lift cylinder). These advantages typically result in an installed savings per lift of several thousand dollars to the owner of the repair shop. The low pressure lift is able to provide comparable lifting force to the load because the effective cross-section area of the lift cylinder is larger than that of the hydraulic cylinder in a high pressure lift. (The lifting force supplied by the lift is equal to the fluid pressure in the lift cylinder multiplied by the area of the face of the moving piston in the lift.)

Two approaches have been taken by the industry to convert pressure from the shop air system to lifting force for the lift. In one, the shop air is plumbed to an external reservoir which is filled with hydraulic fluid. The reservoir is plumbed hydraulicly to the auto lift cylinder. When the shop air pressurizes the hydraulic fluid, the fluid becomes pressurized and applies force directly to the piston in the lift to raise the load on the lift. The other approach is more common in the author's experience, and is illustrated in Figure 1. This section view shows the lift in a position representing almost full retraction to the floor level. The arms which contact the vehicle to be lifted and the plate ("bolster") which connects the rotating arms to the plunger are not shown, in order to keep this illustration simple. The lift contains hydraulic fluid, but the pressurized air is actually used to contact the working face of the plunger (piston) and to raise the load. The hydraulic fluid is used as a means of sealing the pneumatic pressure and of controlling the speed of the plunger through use of an orifice in the bottom of the plunger.

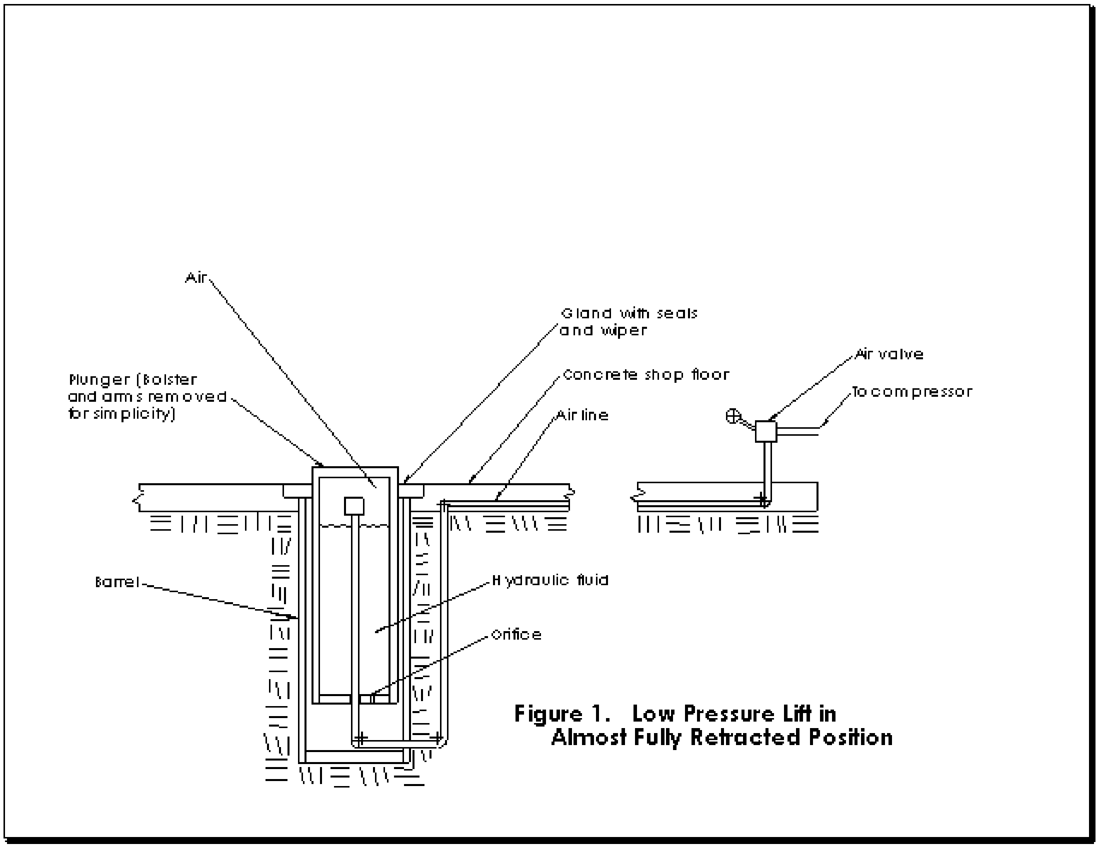

Figure 1.   Low Pressure Lift in Almost Fully Retracted Position

Figure 2. shows the same lift in an extended position. The hydraulic fluid level in the barrel has remained the same, and the plunger has been raised because pressurized air has been directed into the top cavity of the plunger. The barrel of the lift, which is the casing buried in the ground, contains pressurized hydraulic fluid, which is sealed from the environment by means of a gland between the barrel and the plunger containing one or more wiper rings, to prevent the entrainment of dirt, and a dynamic seal system.

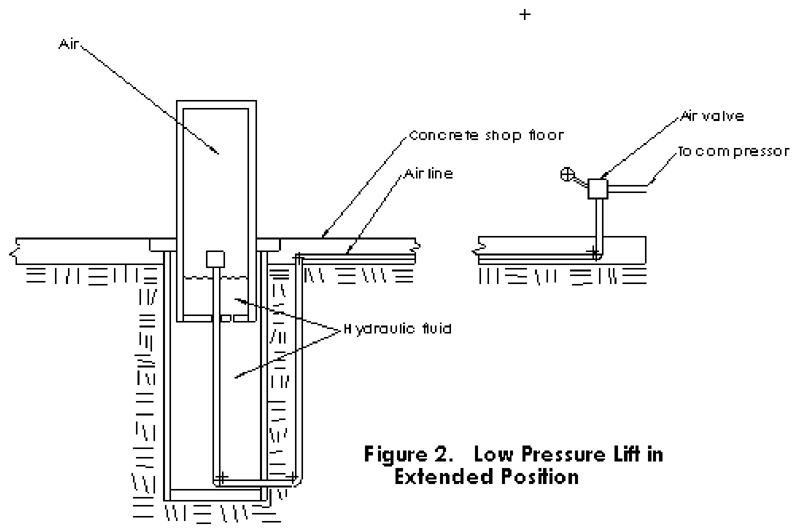

Figure 2. Low Pressure Lift in Extended Position

Lifts with this same general configuration have been sold and installed in repair shops for over fifty years. Some of these lifts have a mechanical lock system (not shown in the figures above) which provide a secondary means of supporting the load when the lift is extended. Although these locks have been available for over fifty years, they have been optional devices on most lifts, and many of the older lifts found in repair shops around the United States do not have them.

Accidents Involving Low Pressure Inground Lifts

One type of serious accident occurs when a lift has been propped up with a bar or beam because the lift has begun to drift down under load. If this prop is accidentally dislodged, or if the mechanic removes the prop without sufficiently pressurizing the lift, the lift can fall and cause very serious injury or death. Another type of accident can occur when a lift has been extended, and the lift abruptly drifts down a distance of a few inches while the mechanic is involved in a repair on the underside of the vehicle on the lift. This can result in injury to the mechanic, depending on the orientation of the mechanic's body when the drift occurs.

A low pressure inground lift can begin drifting down due to leaks in either the pneumatic system or the hydraulic system, since the load is being supported by a column containing both air and hydraulic fluid. Both pneumatic and hydraulic systems actually leak from the time they are new, because no pneumatic or hydraulic seal is perfect. In fact, the operation of hydraulic systems depends on some amount of leakage to prevent premature seal failure. The hydraulic fluid acts as a lubricant, and, in doing so, it must be able to pass, at some rate, by the seals, for example, in the gland between the barrel of the inground lift and the plunger. In a new, well-designed lift, the rate of fall relative to the amount of time the lift is extended for a typical repair is minimal and does not present a safety problem. In older lifts, seal bypass may be excessive and does present a safety problem. Hydraulic fluid may also leak from the bottom of the lift barrel into the ground. This type of leak is difficult to diagnose and repair.

Leaks in the compressed air system present a greater problem. The air line from the air control valve for the lift is typically buried in the concrete floor of the shop or in the soil below the concrete. This air line is usually made from galvanized iron pipe. As any homeowner who has galvanized plumbing in his home knows, fifty year old galvanized pipe buried in an oxygen-rich medium such as soil or concrete is bound to be structurally compromised through oxidation. Leaks through the rusted walls of galvanized pipe allow the hydro-pneumatic system used in the lift to lose pressure. It is possible to imagine a case in which the weakened pipe wall at some point in the system could blow out when pressurized, resulting in the potential for a catastrophic accident. This situation will be mitigated with an appropriately designed orifice in the bottom of the plunger, so that the hydraulic fluid retards the rate of fall of the lift.

Low hydraulic fluid in the lift can result in accidents. If the fluid level is below the orifice in the bottom of the plunger, the plunger can retract more rapidly, since air will pass through a hydraulic orifice faster than hydraulic fluid will. In addition, the sealing gland between the plunger and the top of the lift barrel may not be as well lubricated. When a hydraulic seal dries out, it tends to grab the surface of the plunger and cause erratic motion. Dry seals are a common cause of a phenomenon called "chattering" in the hydraulic business, wherein the unlubricated seals allow jerky rather than smooth motion. Some lift designs incorporate a low level failsafe system. This is typically a float which moves with the hydraulic fluid level and which shuts off the flow of pressurized air to the cavity inside the plunger when the oil level is low.

Standards Governing Auto Lifts

The auto lift industry is like most industries in the United States, in that it is self-governing. A trade organization called the Automotive Lift Institute (ALI) has issued standards for performance, structural integrity, operation, and safety for all types of automotive lifts. These standards are developed in conjunction with the American National Standards Institute (ANSI) and periodically updated.

The earliest voluntary standard covering inground lifts was published by the US Department of Commerce in 1942 and revised in 1947 (Commercial Standard CS142-47). This standard is ambiguous about the application of a secondary locking system to underground lifts. The current standard, ANSI/ALI ALCTV-2006, discusses locking systems clearly and does not allow certification of inground lifts unless an appropriately-designed mechanical locking system is incorporated in the lift. The certification process for auto lifts involves verification of the necessary safety features by examination of the detailed design of the lift model being certified, and it involves third-party load testing of the exact model being certified. However, lifts manufactured and sold in the United States can be marketed without having to meet this or any other standard. Nonetheless, a customer buying an auto lift would be well advised to consider only those lifts which are certified by the ALI, since this means that the lift meets rigorous design guidelines and test criteria. Many large customers such as auto manufacturers do require that lifts installed and used by their dealers be certified. Government bodies, including cities, may include in their building codes or procurement specifications that lifts be ALI certified before the lifts can be installed within their jurisdictions.

Prevention of Accidents

It goes without saying that regular and thorough maintenance will prevent many accidents, for the reasons discussed above. However, there are many low pressure inground lifts in buildings around the United States that are very old. Many of these have passed through several owners as the buildings in which they are installed have changed hands, and the current owners know little about how they work or when they are dangerous. Many of these lifts do not have secondary lock systems because they were not originally procured with the lifts or because they are for some reason inoperative. Although the choice of such a low pressure lift initially represented a significant cost savings for the original owner, doing the necessary excavation, and repairing or retrofitting such old lifts at this point are generally not practical alternatives. In most cases, an unsafe low pressure lift that does not have a functional secondary mechanical lock system should be deactivated and replaced.

The Author

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