A Review on Design and Analysis of Bucket Lift

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ABSTRACT:

Aerial lifts areaccustomed elevate individuals and material to high heights. There are many alternative varieties of aerial lifts that have immensely different dynamics characteristics. The new categorization for aerial lifts was created and organizes them by their kinematics. Several accidents occur whileusing aerial lifts. Hazards of aerial lifts and current solutions to those hazards were reviewed to know the causes of the accidents. Some major accidents arebecause of the complicated dynamics and adaptability of aerial lifts, like oscillations and tip-over. Oscillations of large aerial lifts were through an experiment tested to determine frequencies in several configurations. Machine-motion induced oscillations of an articulating aerial lift were simulated and analysed for each non-overcentre and overcentre configurations. We intend todesign mechanisms that are useful balancingin addition as horizontal swing of bucket and analyse the load distribution dynamic forces to avoid failures in system.

KEYWORDS:aerial work platform (AWP), cherry picker, elevated working platform (EWP).

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1. INTRODUCTION

An **aerial work platform (AWP)**, also known as an **aerial device**, **elevating work platform (EWP)**, or **mobile elevating work platform(MEWP)** is a mechanical device used to provide temporary access for people or equipment to inaccessible areas, usually at height. There are distinct types of mechanized access platforms and the individual types may also be known as a "cherry picker" or a "scissor lift".

Overall most of aerial work platform can be categorized as,

- Scissor lift
- Vertical mass lifts.
- Pulley system lifts.
- Telescopic lifts
- Articulating lifts
- Telescopic articulated lifts

Mechanisms used for Lifting:

As we know there are many numbers of aerial working platforms currently in use. But what makes all the difference in them is the mechanism used for their operation. Drive mechanism is the key difference in the various AWP's which propels it to desired location. Mostly these working platforms are powered by either hydraulics or by pneumatics. Generally hydraulic devices are operated by hydraulic pistons, powered by diesel or gasoline motor's. Similarly pneumatic motors are used for AWP's operation and performance. In case of pneumatic mechanism used.

Now a day's electrically operated light weight platforms are used for maintenance operations in small areas. It results in reduction in its cost as well as rent of heavy and big AWP's. Aerial work lifts have a good vary of appearances; but, all of them are used to position individuals high in the air. Completely different mechanisms are used to perform this lifting motion. The kinematic structure is what separates different types of aerial work lifts. The primary characteristic factor among aerial lifts is directionality of their motion:

i) Solely vertical or ii) vertical and horizontal. A second categorization is the methodology accustomed elevates the work platform. There are three different ways of elevation inside every directional class. Vertical lifts use: i) scissor, ii) vertical mast, and iii) pulley systems. Lifts acting vertical and horizontal motion use:

i) Telescopic,

ii) Articulating, and

iii) Telescopic articulating. The ultimate major way to differentiate aerial lifts is by their ability or inability to drive on the ground while elevated.

Mobility while elevated depends on the bottom of the aerial elevates. Lifts that are able to drive while operating have a cab base to hold the power supply for driving.

1.1 Description and categorisation of AWP's

1. Scissor lift:

A scissor lift is a sort of platform which will typically only move vertically. The mechanism to attain this is the utilization of linked, folding supports in a criss-cross "X" pattern, called a pantograph (or scissor mechanism). The upward motion is achieved by the application of pressure to the surface of the lowest set of supports, elongating the crossing pattern, and propelling the work platform vertically. The platform may have an extending "bridge" to permit closer access to the work space, as a result of the inherent limits of vertical-only movement. The contractions of the scissor action are often hydraulic, pneumatic or mechanical (via a lead screw or rack and pinion system). Counting on the power system used on the lift, it may need no power to enter "descent" mode, however rather an easy release of hydraulic or pneumatic pressure. This is often the main reason that these ways of powering the lifts are preferred, because it permits a fail-safe choice of returning the platform to the bottom by unharnessed of a manual valve. The scissor lift was 1st patented in 1963 by Charles Larson of the USA. Articulated lift being demonstrated "Spider" discovered outside a building. Hotel lift there's variety of smaller lifts that use mechanical devices to extend, like rack and pinion or screw threads. These typically have close sections that move past each other so as to make the movement, typically during a vertical direction only. These lifts usually have restricted capability in terms of weight and extension, and are most frequently used for internal maintenance tasks, like changing light bulbs. [11]

A. Motive mechanisms:

AWPs, by their nature, are designed for temporary works and so oftentimes need transportation between sites, or just around a single site (often as a part of a similar job). For this reason, they're the majority designed for straightforward movement.

B. Unpowered;

These typically smaller units haven't any motive drive and need external force to manoeuvre them. Dependent on size and whether or not they are wheeled or otherwise supported, this may be attainable by hand, or may need a vehicle for towing or transport. Small non-powered AWPs may be light enough to be transported in a pickup truck bed, and may typically be stirred through a standard doorway.[11]

C. Self-propelled:

These units are able to drive themselves (on wheels or tracks) around a site} (they typically need to be transported to a site, for reasons of safety and economy). In some instances, these units are able to move while the job is current, though this can be insufferable on units that need secure outriggers, and so most typical on the scissor lift varieties. the facility may be nearly any kind of normal mechanical drive system, as well as electrical or gasoline powered, or in some cases, a hybrid (especially where it's going to be used both inside and outside). Such person lifts are distinguished from telescopic handlers in this the latter are true cranes designed to deliver cargo loads such as pallets filled with construction materials (rather than simply an individual with some tools).[11]

D. Vehicle-mounted:

Some units are mounted on a vehicle, usually a truck or it can be mounted on a flat back pick up van referred to as a self-drive, though alternative vehicles are possible, such as railway cars. This vehicle provides mobility, and should additionally facilitate stabilize the unit — though outrigger stabilizers are still typical, particularly as vehicle-mounted AWPs are amongst the most important of their kind. The vehicle may additionally increase functionality by serving as mobile workshop or store. An extended scissor lift A Palazzani TSJ 24 in Hong Kong Telescoping articulated platform mounted lighted fighting appliance. These offer a lot of flexibility than ladder engines.[11]

E. Control:

The power assisted drive (if fitted) and lift functions of an AWP are controlled by an operator, who can be placed either on the work platform itself, or at a control panel at the base of the unit. Some models are fitted with a panel at both locations or with a remote control, giving operator alternative of position. a control panel at the base can even perform as a security feature if for any reason the operator is at height and becomes unable to work his controls. Even models not fitted with a control panel at the base are typically fitted with an emergency switch of some type, that permits manual lowering of the raise (usually by the discharge of hydraulic or pneumatic pressure) within the event of an emergency or breakdown. Controls vary by model, but are frequently either buttons or a joystick. The type and complexness of these can rely upon the functions the platform is able to perform. The controls will control options such as:

- Vertical movement
- Lateral movement
- Rotational movement (cardinal direction)
- Platform / basket movement — usually, the system mechanically levels the platform, despite
- Boom position, however some permit overrides, tilting up to 90° for add troublesome locations.
- Ground movement (in self-propelled models)[11]

F. Safety:

The majority of makers and operators have strict safety criteria for the operation of AWPs. In some countries, a licence and/or insurance is needed to work some sorts of AWP. Most protocols advocate training every operator, whether or not mandated or not. Most operators also order a variety of pre-usage checks of the unit, and makers suggest regular maintenance schedules. Work platforms square measure fitted with safety or guard rails round the platform itself to contain operators and passengers. This is often supplemented in most models by a restraining purpose, designed to secure a harness or fall constraint. Some work platforms even have a lip round the floor of the platform itself to avoid tools or provides being accidentally kicked off the platform. Some protocols need all equipment to be attached to the structure by individual lanyards. Extreme caution should be taken once using AWPs within the section of overhead power lines, as electrocution may result if the raise comes in contact with energized wiring. Non-conductive materials, like covering material, could also be accustomed reduce this hazard. AWPs typically come back equipped with a spread of tilt sensors. The foremost unremarkably activated sensor (especially with 2 folks on a lift), can cause the machine to refuse to lift the platform on the far side a certain height. Sensors at intervals the machine find that weight on the platform is off balance to such a point on risk attainable tip-over if the platform is raised additional. Another sensing element can refuse to extend the platform if the machine is on a major incline. Some models of AWPs in addition feature counterweights, which extend in order to offset the danger of tipping the machine inherent in extending things like booms or bridges. Some lifts are fitted with sensors which can prevent operation if the load on the platform exceeds the safe work.[11]

2. LITERATURE REVIEW

Ehasanmaleki et al 2 Studied that the Cherrypickers are a vital category of machines that transporthumans to high heights. Understanding the dynamics andstability of the machines is crucial for economical and safe operation.The design of a portable cherrypicker was given. A dynamicmodel was developed to capture the oscillating dynamicsof the machine. Simulation studies illustrated the advanced dynamic behaviour of the machine. An input-shaping controller wasadded to the system and also the oscillating dynamics were greatlyreduced. [1]

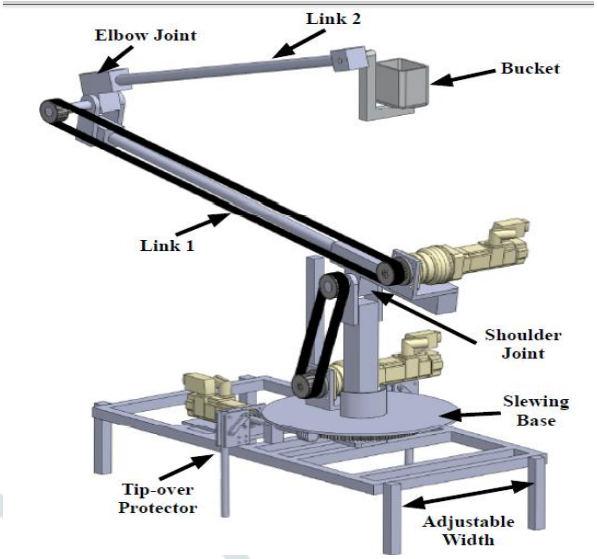

Figure 1 Modelling portable cherry picker [1]

William K. Holmes, et al 2 has worked on Bucket Levelling System. He describes that In on Articulated boom assembly bucket is mounted at the outer end. Upper arm is extended by hydraulic cylinder with respect to lower arm. For rotational position of the bucket rotary actuator is provided .When arms are operated to raise and lower the assembly hydraulic fluid is provided to rotary actuator to maintain the bucket position .It also includes a chain and sprocket. It compensates upper boom angles and relatively bucket balance is maintained.[9]

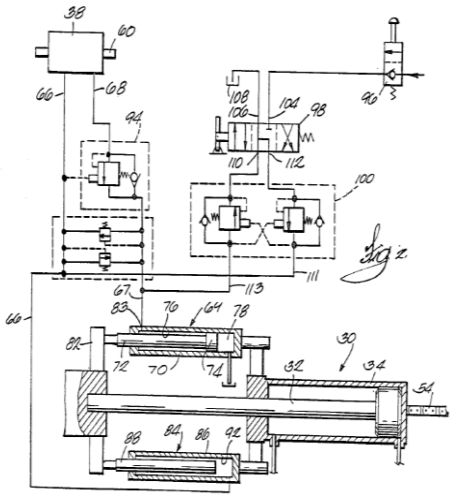

Figure 2.Hydraulic circuit of balancing of bucket [9]

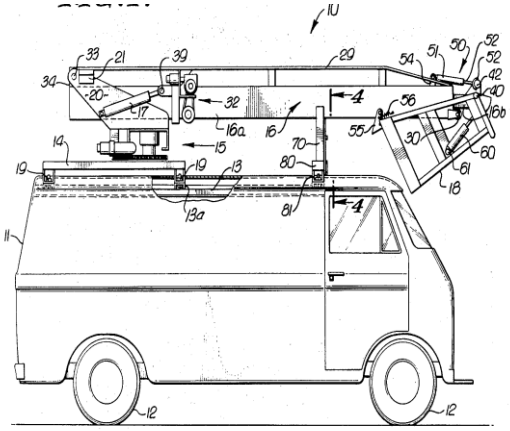

Figure 3 Vehicle mounted bucket lift [5]

Edward V. Garnett, et al 2 has successfully studied Extensible Ladder Assembly An Aerial Basket Therefore An extensive ladder is mounted on a vehicle to be pivotal upward and downward by piston mechanism positioned to the facet of the pivotal path of ladder travel. An aerial basket is pivotally mounted on the ladder that has its motion damped to stop abrupt changes in basket angle. Included are arrangements for mechanically storing the basket on ladder retraction and for supporting the ladder during a rest position over the vehicle roof. The ladder rest arrangement may bepositioned to allow depression of the ladder to the vehicle roof.[5]

Robert A. Beucher found lifting mechanisms of bucket lift. Apparatus for raising and lowering workmen and tools into proximity with elevated structures throughout construction and repair thereof includes a platform, a frame and a hydraulically-actuated linkage assembly connecting the platform to the frame.[10] The linkage assembly includes an elongated boom assembly pivotally connected to one end of the platform, a compression member assembly pivotally connected to one end of the frame and to the boom assembly,and a tension member assembly pivotally connecting the opposite end of the boom assembly to the frame. A main hydraulic actuator is connected between the compression member assembly and also the frame and operates upon extension to pivot the compression member assembly in one direction to cause the tension member assembly to pivot the boom assembly within the different direction for raising the platform. Auxiliary hydraulic actuator means connects the boom assembly to the platform, and an automatic levelling system is provided to control the auxiliary actuator suggests that for maintaining the platform level throughout rising and lowering there from.[10]

Edward E. Griffith has invented Auto-Levelled Crane Boom Man Baskets. An automatic levelling device for crane boom supported work baskets includes a weighted and clamped plumb sensing element coupled to a. initial potentiometer and a second potentiometer for measure the relative angle between the Crane boom and also the basket pivotally hooked up thereto- The measured Output levels of the 2 Potentiometers are applied to a servo circuit that controls a linear power mechanism pivotally hooked up between the boom and basket to thereby maintain the basket vertical. The basket is also electrically isolated from grounded to be used on "live" wire maintenance once the basket carries a accumulator for powering the servo and mechanism and if the basket controls for boom movement are transmitted to the Crane through a fibre optic or radio remote control link.[6]

Nico zimmert, et al 2 has studied2-DOF Control of a Fire-Rescue Turntable Ladder. Modern fire-rescue turntable ladders are build to be in light-weight of construction to extend their most operation velocities, maximum length, and reaching. Hence, the truss structure of the ladder set provides a restricted stiffness and is subject to bending oscillations in the numerous modes. To damp these oscillations with its hydraulic drives, a 2-degree-of-freedom control is planned during this paper. The feed forward control relies on the differential flatness of an easy multi body system by only considering the basic oscillations. Using Euler–Bernoulli beam theory, the dominant modes of oscillation are taken into account throughout feedback control design.[2] The model parameters are assumed discontinuous however piecewise constant over the ladder length while the cage at the free end is accounted for by dynamic boundary conditions. Based on the analytical sort of the Eigen functions the modal illustration of the system is derived. It is used to design a feedback controller and to merge the measuring information of the gyroscope with the measurements of the strain gauges. The planned control approach permits for damping of the dominant modes and for asymptotically stabilizing the system around a reference trajectory. a crucial demand on the planned approach is to derive a control law that accounts for the low machine power of the ladder's microcontroller. The proposed control conception is enforced in fixed-point arithmetic on the control unit running the turntable ladders created by the market leader IVECO MagirusBrandschutztechnik GmbH. [2]

Scope:

This program applies to all Company employees and outlines a minimum set of standards for preventing employee incidents involving the use of Aerial Lifts. This program outlines a set of safety

requirements to be followed using Elevating Work Platforms (EWP) and Aerial Devices (AD). All employees involved with EWP's and AD's will be trained to perform their task in a safe and efficient manner. Not all equipment to be operated or all regulations may be identified in this policy, and as such if the equipment or regulation is not listed in this policy refer to the Standards and/or the manufacturer for requirements for its safe operation. This program is not meant to take the place of knowledge of any and all applicable regulations as they pertain to this procedure.

3. CONCLUSION

AWP's are an important class of machines that transport humans to high heights. Understanding the dynamics and stability of the machines is crucial for efficient and safe operation .A dynamic model should be developed to capture the oscillatory dynamics of the machine. The complex dynamic behaviour of the machines should be studied deeply. An input-shaping controller should be added to the system to reduce the oscillatory dynamics. A proper auto levelling mechanism and swing mechanisms should be chosen and designed for having increase in functionality as well as safety.

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