ISSN 1041-9489

SAFETY BRIEF

March, 2002

Volume 20, No. 1

Triodyne Inc.

Consulting Engineers & Scientists – Safety Philosophy & Technology

5950 West Touhy Avenue Niles, IL 60714-4610

(847) 677-4730 FAX: (847) 647-2047

e-mail: infoserv@triodyne.com *www.triodyne.com*

Forklift Mounted Self-Dumping Hoppers
Counter Latch Invention

By Ralph L. Barnett* and Christopher Ferrone**

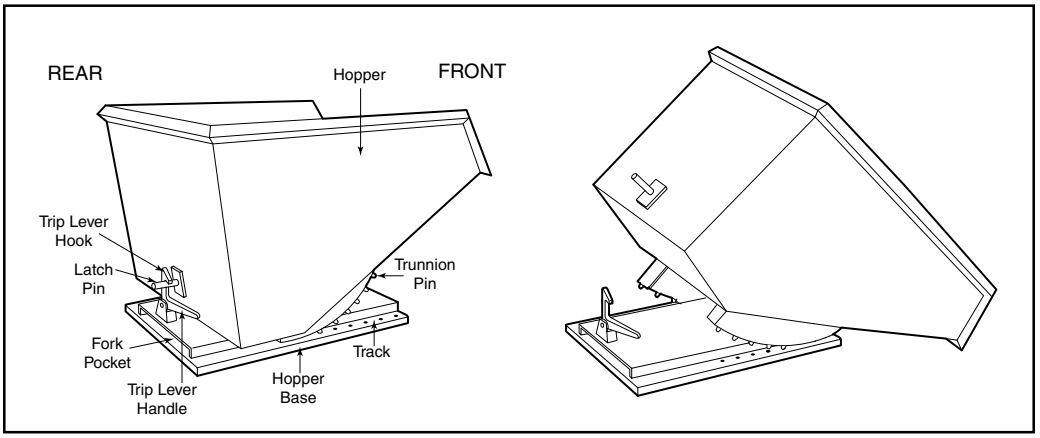

Figure 1 - Self-Dumping Hopper

Abstract

A safety device is proposed that will enable the operator of a sit-down rider forklift to discharge a self-dumping hopper while seated at the control station. Dumping proceeds without ground personnel which removes them from traffic flow and protects them from impacting loads that overspill the hopper, roll, bounce, or are accidentally discharged from the hopper. Just the right amount of rearward mast tilt is normally required to overcome the latching resistance of heavily loaded forward biased hoppers without becoming relatched when the trip lever is released. The associated trial and error balancing procedure is eliminated together with any need for muscling the latch rod. Unlatching poles are no longer used for elevated dumping.

I. Introduction

A self-dumping hopper is depicted in Fig. 1 in both its latched and dumping configurations. The unit is usually supported on the tines of a forklift truck which enter the fork pockets in the base in the same fashion that a pallet is handled. Gravity maintains the hopper on a gear-like track that causes it to both dump and move forward in synchronization. When the base and track are level, an empty or uniformly loaded hopper will tend to rotate forward which causes its center of gravity to move even further forward to accelerate the dumping action. The forward tilt capability of the forklift mast may be used to move the center of gravity of an empty or loaded hopper in a forward direction; conversely, rear tilt moves the center of gravity rearward which diminishes the tendency of the hopper to dump and usually urges it into a rearward rest position against its stops.

* Professor, Mechanical & Aerospace Engineering, Illinois Institute of Technology, Chicago, IL; Chairman, Triodyne Inc., Niles, IL

** Senior Mechanical Engineer, Triodyne Inc., Niles, IL.

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(847) 677-4730
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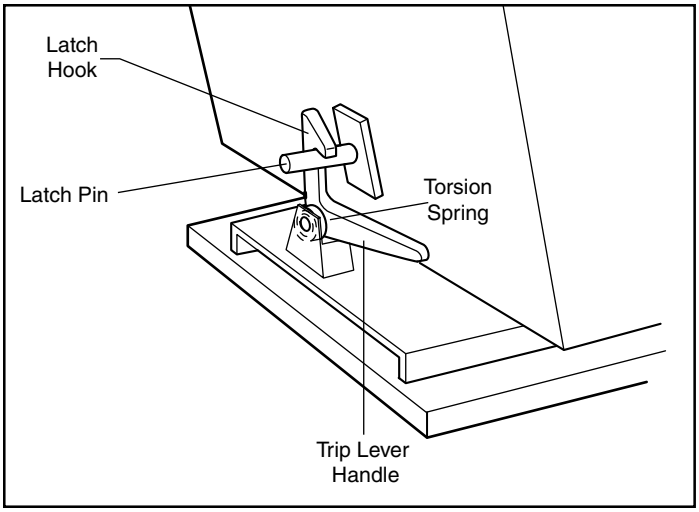

Figure 2 - Conventional Hopper Latching System

When the hopper is in its latched or fixed state it may be used for loading, storing, or transporting lading. The fixed state is maintained by a latching system that is typified in Fig. 2. The latch is comprised of a hopper mounted latch pin, a frame mounted hook which is spring loaded to engage the pin, and a handle integral with the hook for manual disengagement.

Standard Operating Protocols

Normally, self-dumping hoppers are strategically located in a factory setting and simply rest with their bases on a floor or ground surface. When filled, the latched self-dumping hopper is transported as a conventional forklift load. The hopper is lifted 2 to 4 inches off the surface with the forklift's mast fully tilted rearward and it is then moved slowly to a dumpster. The lowered hopper is positioned, the forklift is put into neutral with the parking brake set, and then the forks are raised sufficiently high to avoid horizontal interference with the container when the self-dumping hopper moves fully forward. Raising the trip lever handle with the forklift mast vertical begins the dump cycle by unlatching the latch hook from the latch pin. Under uniform hopper loading, the hopper dumps automatically. To restore the hopper to its inboard latched position, several methods may be employed:

A. The mast may be tilted rearward.

B. The forklift may be backed up slightly and then stopped abruptly.

C. A pole may be used to push up on the front of the hopper.

D. The forks may be lowered to the ground and the empty hopper may be lifted by hand.

Occasionally, the hopper may be heavily loaded with its center of gravity biased forward. This creates a large upward force on the hook which cannot be overcome by manually lifting the trip lever handle or pushing up on it with a pole. This upward force becomes smaller and smaller as the mast is continually tilted rearward. Normally, in the extreme position where the mast is fully tilted inboard, the unlatching resistance is provided solely by the torsion latch spring; the loaded hopper no longer contributes to the latching resistance. Here, the hopper easily unlatches, however, it will relatch immediately if the trip lever handle is released. In a two-person operation, the trip lever handle may be held in the upward or unlatched condition by the ground man while the forklift operator begins the dump cycle. Unfortunately, the full inboard mast orientation precludes dumping by a single operator. One person cannot maintain the hopper in an unlatched state and mount the forklift and tilt the mast forward to dump. In a one-person protocol, the operator must seek an intermediate mast tilt between "too far forward to release the hook" and "not too far rearward that the hook relatches." Trial and error is used to establish an appropriate mast angle in a range where one finds "release without relatching."

Description of Counter Latch Invention

If dumping is to proceed from the control station of a forklift during a one-person operation, an easy to release latch system is required that will not redeploy until dumping begins. A suitable device would satisfy the following qualifications:

1. Initiates the dumping cycle at the rearmost position of mast tilt where unlatching the hopper is least strenuous.

2. May be optionally deployed to prevent relatching at extreme rearward mast angles, or it may be ignored to leave the original system unaltered.

3. It must be located near the latching system where it can be manually engaged at ground level.

4. After the device is engaged, it must automatically cause the original latching system to return to its normal state when the hopper moves forward. This will permit conventional relatching after the lading is dumped.

A "Hopper Mounted Counter Latch" is illustrated in Fig. 3a which fulfills the foregoing qualifications. The device is a spring loaded cantilever rod hinged to the rear hopper panel. When the trip lever handle is raised against the countertorque of its torsion spring, the rod is manually swung horizontally into the return path of the handle. The resulting interference prevents relatching as shown in Fig. 3b. Because the rod is spring loaded to lay flat against the hopper, a detent is added to the bottom of the trip lever handle to maintain the rod in its interference position.

The hopper shown in Fig. 3b is biased rearward; in general this is caused by uneven loading or by rearward tilting of the

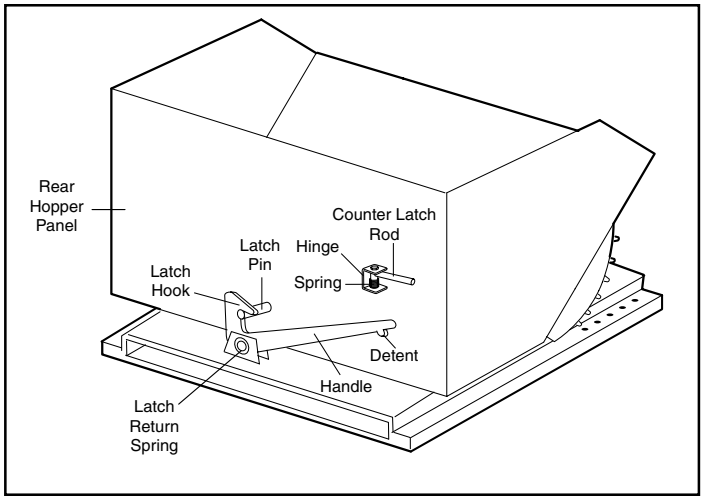

Figure 3a - Hopper Mounted Counter Latch

mast on a supporting forklift. Clearly, if the handle were allowed to descend, the hook would relatch the latch pin. The condition depicted in Fig. 3b allows a single operator to mount the forklift and raise the hopper up to its dumping elevation. Now, when the mast is tilted forward, the hopper begins to move forward into its dumping mode. This causes the rod in Fig. 3c to begin to pull out from under the handle. A moment later, simultaneously, the spring loaded rod snaps back against the hopper and the torsion loaded trip lever handle springs downward as illustrated in Fig. 3d. Observe that the original latch system is ready to relatch the hopper after it returns from its dumping phase.

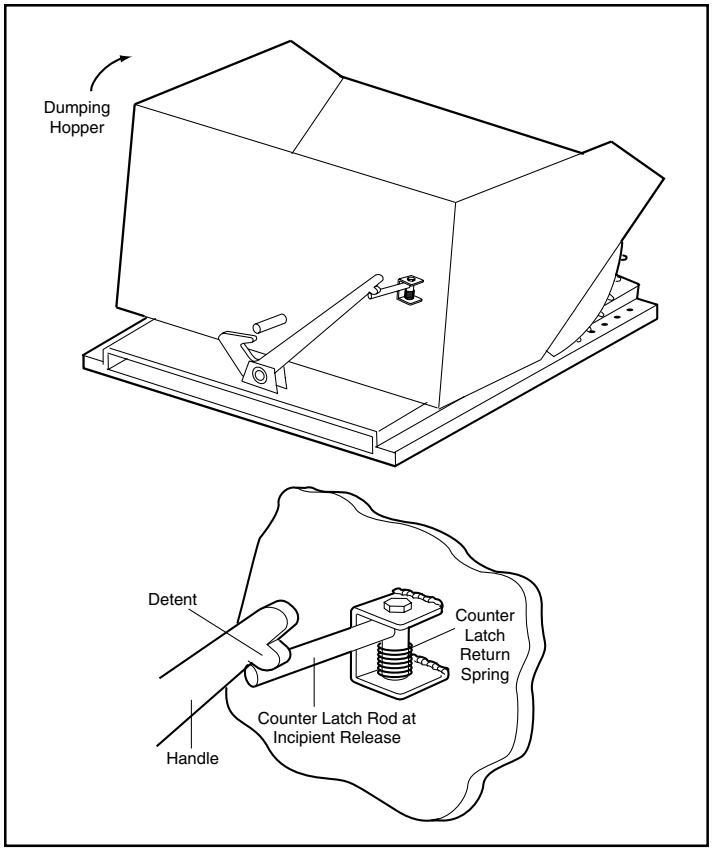

Figure 3c - Beginning of Hopper Dump

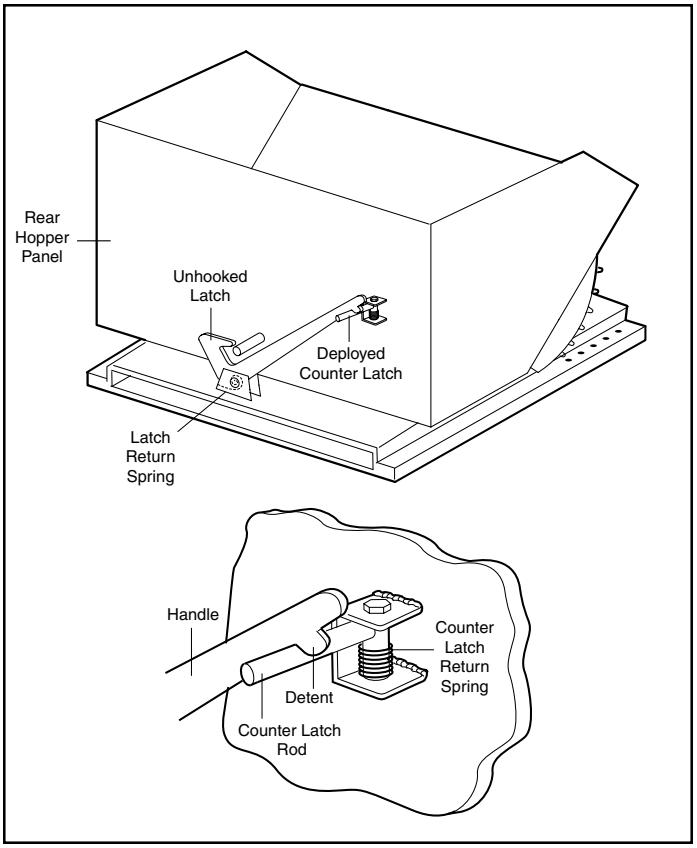

Figure 3b - Unlatched Hopper During Rearward Bias

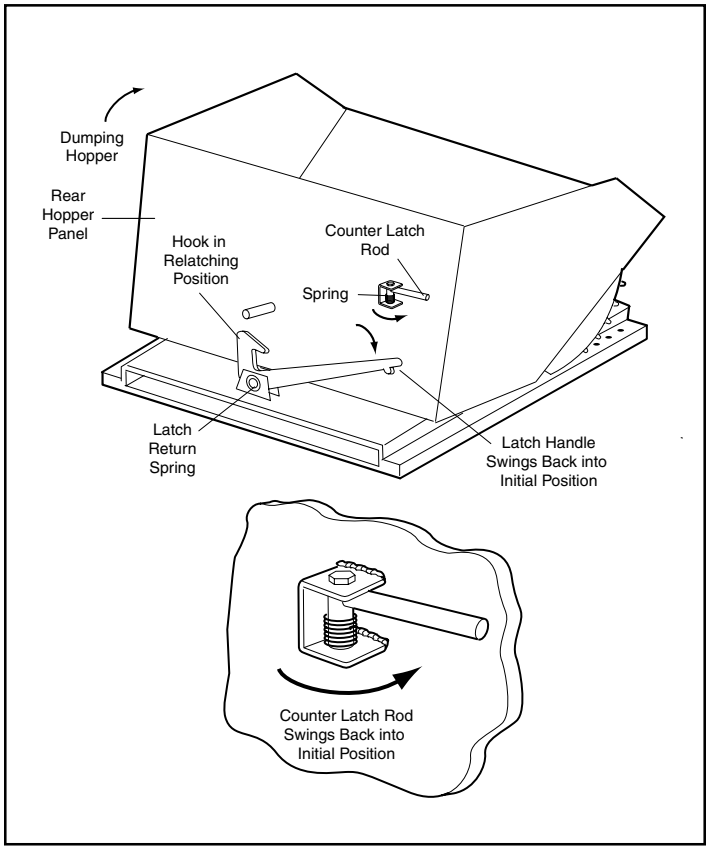

Figure 3d - Dumping Hopper
Latch and Counter Latch in Initial Positions

Two additional counter latch candidates are described in the Appendix; one is frame mounted and the other is handle mounted.

Operating Protocols With Counter Latching

All loading, storing, and transporting of self-dumping hoppers proceed as normal with the hopper in a latched position and the counter latch at home base with the rod flat against the hopper panel. When a filled hopper arrives at its dump site, its associated forklift has its mast fully retracted and its forks lowered. Either the forklift operator or ground personnel begin the dumping scenario by first lifting the trip lever handle; minimum resistance will be encountered because the mast is fully retracted. While holding the handle in one hand, the counter latch may be deployed with the other and the handle suitably seated in the detent.

The area is cleared of ground personnel and the seated forklift operator raises the hopper to the proper dumping elevation and tilts the mast forward to begin dumping. The latch and counter latch return automatically under spring forces to their non-deployed states. The empty hopper is then relatched using the usual techniques. Note that without the counter latch, the latch hook will reset itself when the hopper is retracted. Figure 3d indicates that a downward acting latch pin will act on the top sloped surface of the hook to reopen and relatch it.

The counter latch is only used at the beginning of a dump cycle and, sometimes, not at all.

Conclusions:

The counter latch inventions enhance the safety of self-dumping hoppers in the following ways:

1. Operators never contact any part of a self-dumping hopper when the hopper is moving or elevated.

2. Before dumping proceeds, the ground personnel can evacuate the entire area. This eliminates any danger associated with overspilling lading, hopper discharge, or errant bouncing and rolling scenarios.

3. Physical exertions are limited to overcoming the resistance of the trip lever spring.

4. Any motivation to introduce pull cord unlatching systems is eliminated together with over two dozen hazards associated with “cables in the workplace.”

5. Any temptation to manipulate tilting controls from the ground for trial and error balancing is eliminated.

The counter latch also provides several functional advantages, i.e.,

1. Push rods are almost never required.

2. Trial and error balancing procedures are no longer needed for one-man operations involving heavy forward biased loads.

3. Operators may choose to ignore the counter latching device altogether and operate as usual.

4. A broken counter latch introduces no new dangers.

Acknowledgments

William Brown and Charles Sinkovits are co-inventors with Ralph Barnett of the counter latching devices described in this paper.

Appendix

The body of this paper describes a counter latch which is mounted on the rear panel of the hopper. Two additional concepts are presented in this appendix where the counter latches are mounted on either the latch handle or the hopper base. The idea, once again, is that the latch handle is propped up after the hopper is unlatched in the extreme rearward tilt position and the prop is caused to spring return to its original “unpropped” position after the hopper moves forward.

Latch Handle Mounted Counter Latch

Figure 4a depicts the initial position of a latched hopper with a handle mounted counter latch held in its initial undeployed location by a torsion spring. The counter latch prop is illustrated in its horizontal deployed orientation in Fig. 4b where it is assumed that the hopper is supported by a forklift whose mast is tilted fully rearward.

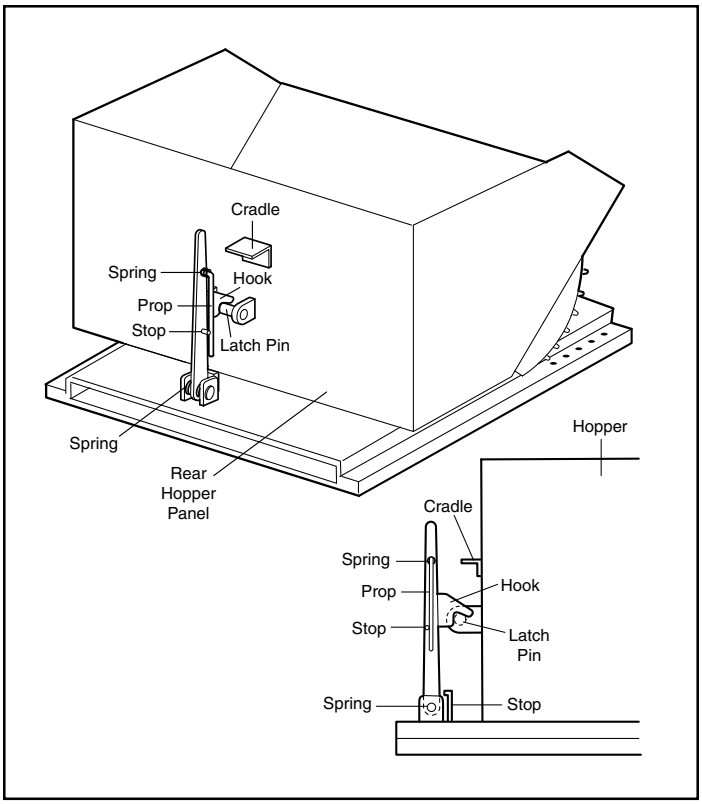

Figure 4a - Hopper in Initial Position

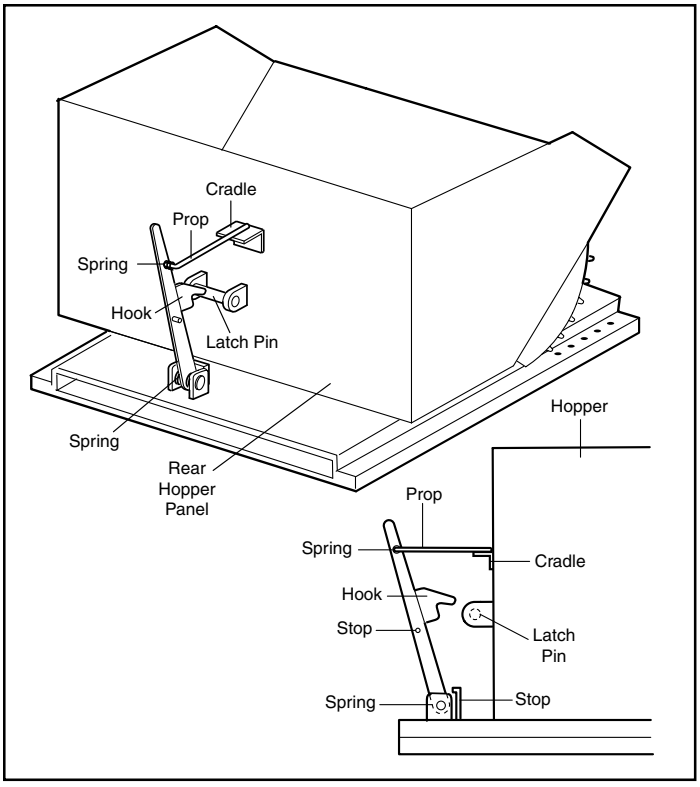

Figure 4b - Unlatched Hopper During Rearward Bias

The dump cycle is begun by tilting the hopper forward. The prop and latch handle will follow the hopper until the latch handle contacts its stop. Continued forward movement of the hopper will cause the prop to leave the cradle and spring into its initial orientation as shown in Fig. 4d. Figure 4c depicts the prop at the point of incipient release.

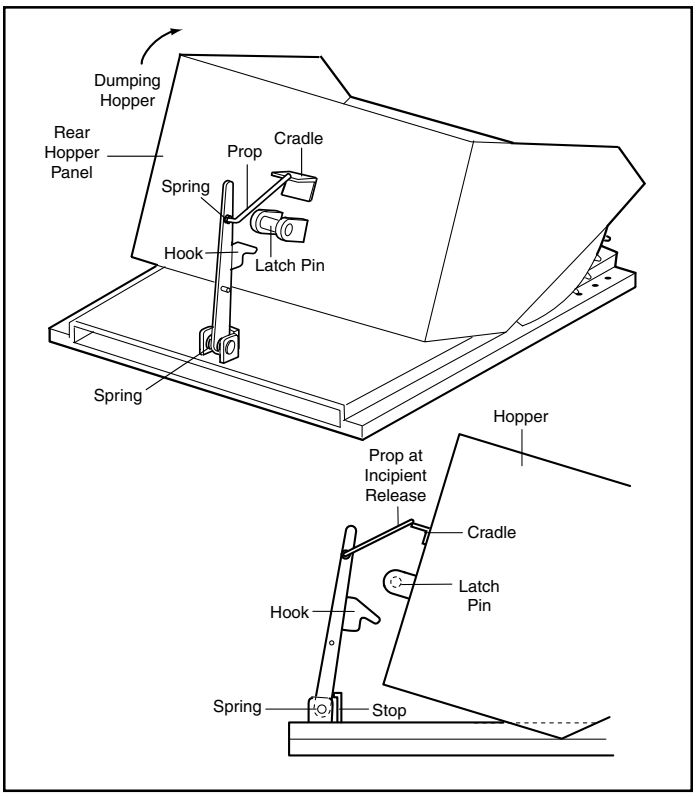

Figure 4c - Beginning of Hopper Dump

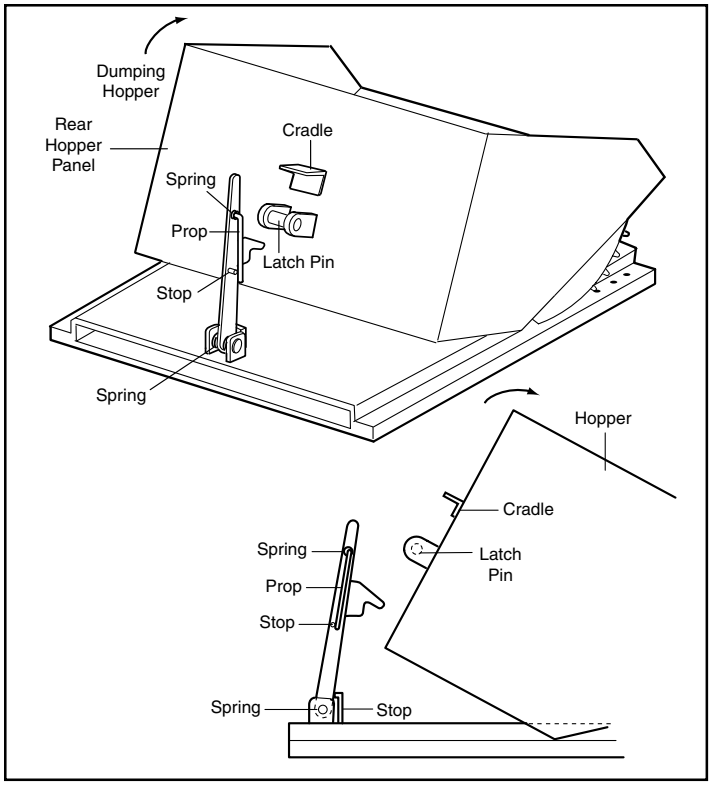

Figure 4d - Dumping Hopper Latch and Prop in Initial Position

Hopper Base Mounted Counter Latch

A latched hopper is shown in Fig. 5a with a base mounted counter latch in its initial undeployed orientation. The prop is spring loaded to urge it into a horizontal position; the free end is

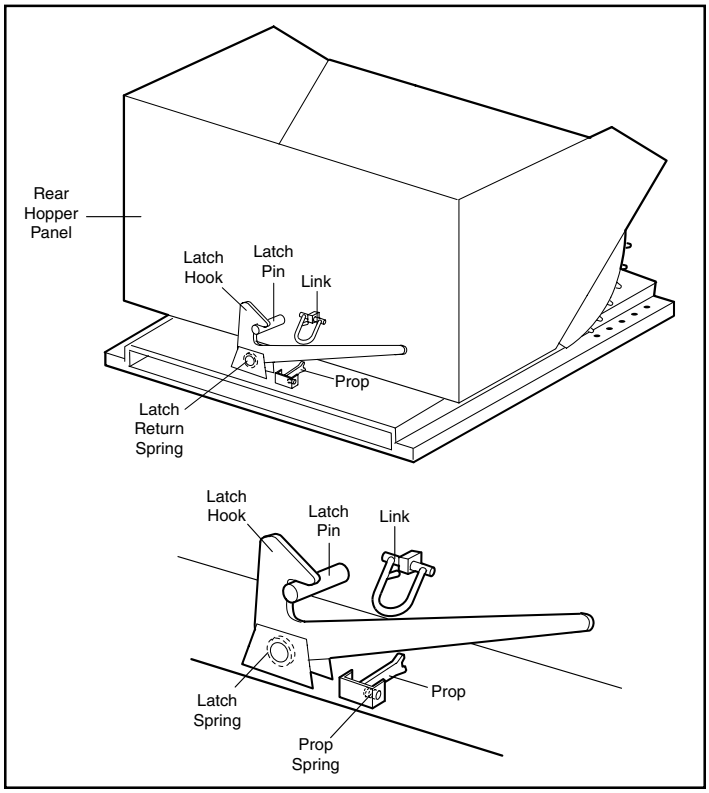

Figure 5a - Hopper in Initial Position

saddle shaped to engage the latch lever handle. To maintain the latch lever in a raised (unlatched) state, given a hopper with a rearward bias, the prop is manually deployed vertically so that the latch lever may be set in the saddle. This is illustrated in Fig. 5b where we observe that the prop resists the clockwise urging of the latch spring and the saddle resists the tendency of the prop to return it to its horizontal position.

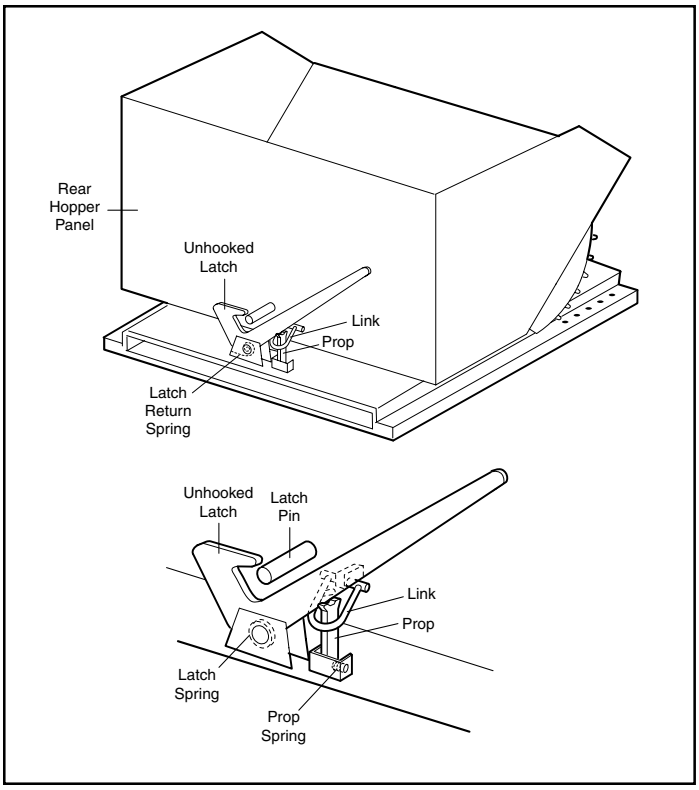

Figure 5b - Unlatched Hopper During Rearward Bias

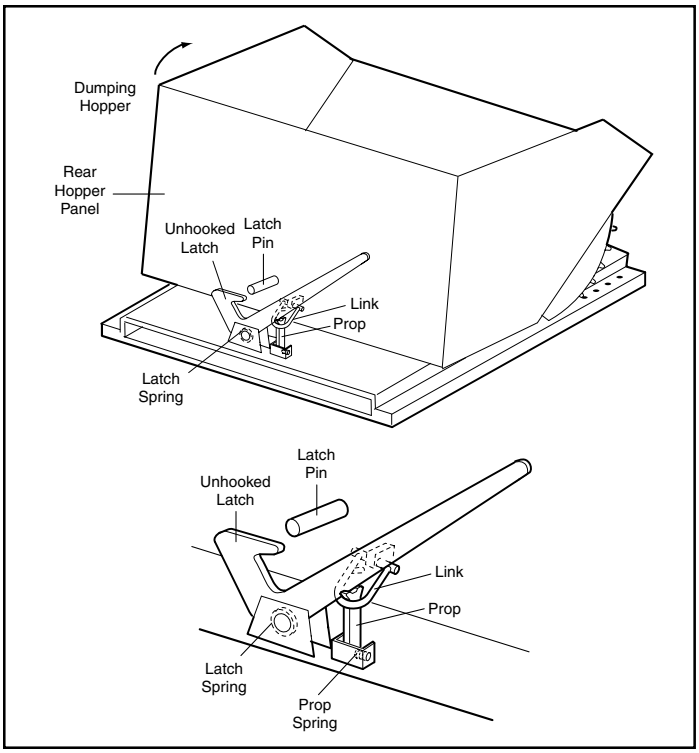

Figure 5c - Beginning of Hopper Dump

A hopper mounted release link is depicted in Fig. 5b that will pull the prop from under the latch lever arm when the hopper moves forward. As illustrated in Fig. 5c, the link is poised to release the prop at the beginning of the hopper dump cycle. Figure 5d describes the geometry of the latch handle and prop after the hopper moves forward. Note that the prop is resting in its initial location and the latch hook is oriented to receive and relatch a returning hopper.

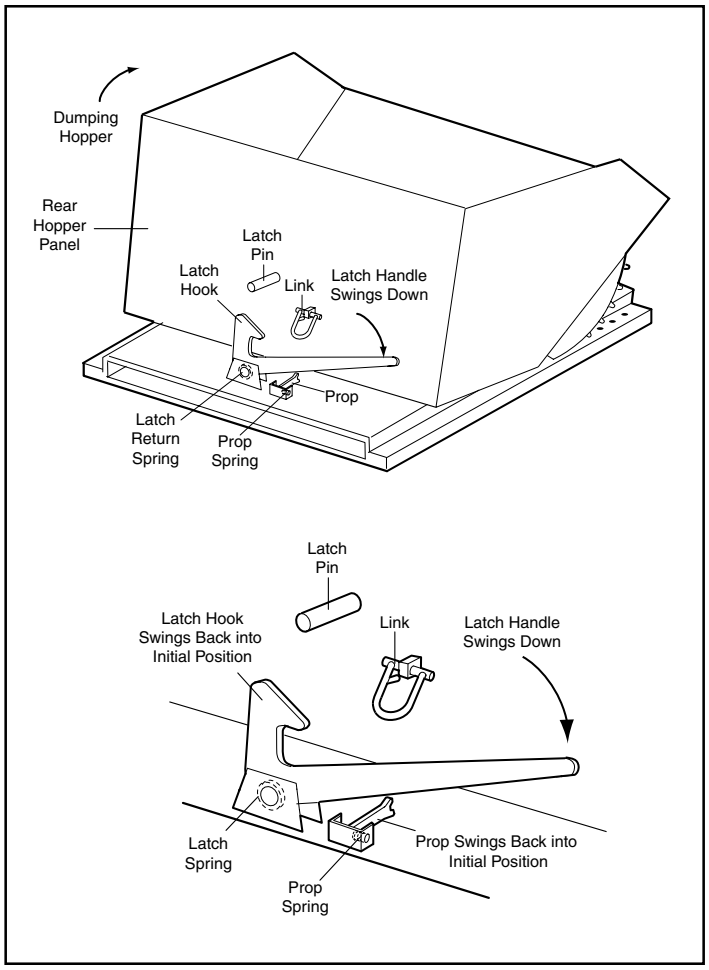

Figure 5d - Dumping Hopper
Latch and Prop in Initial Position

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March, 2002 – Volume 20, No. 1

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