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Special Report 42

**CONSERVATION OF
M29C WEASEL TRACKS**

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CONSERVATION OF M29C
WEASEL TRACKS

by
John J. Lanyon

September 1962

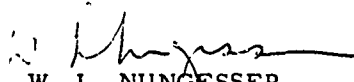
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Hanover, New Hampshire

PREFACE

This report presents the results of a study made at Keweenaw Field Station, Houghton, Michigan, to improve the track system of the M29C Weasel for use in extensive arctic travel.

The work was carried out under USA SIPRE* Project 022.02.008 (now subtask 5010.02206) "Principles of oversnow vehicle design," by Mr. Lanyon, project engineer, under the supervision of W. K. Boyd, then chief, Applied Research Branch. E. R. Jackovich assisted in the program.

This report has been reviewed and approved for publication by the Office of the Chief of Engineers, United States Army.


W. L. NUNGESSER
Colonel, Corps of Engineers
Director

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* Redesignated U. S. Army Cold Regions Research and Engineering Laboratory, Corps of Engineers (USA CRREL), 1 February 1961.

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SUMMARY

In the winter of 1958-59, tests were conducted to improve the usefulness of the M29C weasel track system for extensive travel in arctic regions and conserve the remaining supply of weasel tracks. A standard weasel track was cut into five equal lengths and rejoined with specially designed links to form a sectionalized track. Five different types of links were constructed and tested.

A test course 2.3 miles long with three different terrains was prepared to test the track links under similar conditions. A standard M29C weasel equipped with the test track was used in the testing.

The links tested were: (1) a piano hinge type which connects two pads by a long pin, (2) a cold roll steel link designed to contain the cut ends of the track belts, (3) a cold roll steel link machined to fit the contour of the inner surface of the pad, (4) an aluminum link of the same configuration as the machine steel and containing a hardened steel insert in its pinhole, and (5) a steel link designed primarily to make emergency repairs to the outer bands of an unsectionalized track in the field.

Of the four links designed to rejoin sectionalized track, the aluminum link with a hardened steel insert proved to be the most satisfactory.

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INTRODUCTION

The problem of procuring, transporting, and maintaining the track and suspension systems of oversnow track-laying vehicles is of great concern to those responsible for the planning and execution of extensive travel in arctic regions.

Of the vehicles most commonly used, the standard M29C Weasel coupled to a M14 one-ton cargo sled is probably considered the most useful. However, its one-piece continuous belt track detracts from its popularity and usefulness.

Disadvantages of a one-piece continuous belt track

A one-piece continuous belt track has three main disadvantages. First, the whole track must be discarded when broken, regardless of age or condition. It is possible, even with the correct amount of tension in the track belts, to drive a weasel into a position that will cause an excessive amount of slack in the track. If an attempt is made to turn the vehicle at this time, the track guide, which is in the center of the track, tends to climb the drive sprocket, placing a high tension in the track belts and usually causing the outer support band to break. Breaks of this type are quite common; when they occur, the whole track is usually discarded, wasting the good parts of the track. Second, a one-piece track is much more difficult to maintain. Replacing a track in the field away from convenient shop facilities is usually a major task. Also, a common practice of late is to construct a larger, more commodious cab on weasels used for extensive arctic travel. The sides of these cabs usually extend out over the tracks, making it even more difficult to replace the one-piece continuous band track. Third, the large bulk of a whole track, used for only one repair, consumes valuable space needed for other supplies. It is customary, when using a M29C Weasel for extensive arctic travel, to couple to it a standard M17 one-ton cargo sled carrying fuel, rations, spare parts, and other necessary supplies. To insure against becoming immobile through track failure, a spare track usually is included among the spare parts. A whole one-piece track (29 ft³ crated) consumes approximately 50% of the deck space of the sled.

In addition, production of M29C Weasel tracks has been discontinued for several years and is not likely to be resumed; therefore, some serious thought should be given to making the present supply last as long as possible.

It is possible to increase the probable life span of a weasel track by merely fastening a roller chain of sufficient strength between the inner and outer bands of the track. This increased strength enables the track to withstand the high stresses which may be accidentally placed upon it but exceeds the original design strength of the track. If the track is unable to release the high stresses, more serious damage is likely to occur to the drive sprockets and front idlers. A properly designed track acts as a safety link to prevent more serious damage. This is also true of a track constructed by connecting individual track pads by chain links. Higher tension may be applied to the track but only at the risk of excessive wear and ultimate failure of other parts of the suspension system.

By cutting a weasel track into sections and rejoining the sections with a specially designed link, the original design strength of the track is retained, and the general characteristics of the track remain approximately the same.

Advantages of a sectionalized weasel track

When a sectionalized weasel track breaks, only the damaged section needs to be replaced. The remaining sections may be used until they break, which increases the track life considerably.

Another advantage is that a broken sectionalized track is simpler to repair. To replace a section, the track is assembled and laid out flat behind the vehicle. The lead end of the track is then engaged in the teeth of the drive sprocket. By placing the transmission in low gear, low range, the starter motor may be used to power the track around

the front idler and back under the bogie wheels to the rear of the vehicle, where it may be connected at some convenient point. A wire or rope tied to the lead end of the track will assist greatly in guiding the track and simplify the procedure. Third, use of a sectionalized track can reduce the bulk of track to be carried for one repair from 29 ft³ to 2 ft³.

In USA SIPRE's* 1958-59 winter test program, different types of sectionalized tracks were tested. A standard weasel track was cut into five equal lengths, and five types of connecting links to join the track sections were designed, constructed and tested.

DESCRIPTION OF STUDY

Types of connecting links

The first type of connecting link designed was a piano-hinge type fabricated by Chief Warrant Officer Martin, then with the 1st Engineer Arctic Task Force. It consisted of two specially constructed plates in the shape of track pads to which 1-in. lengths of $\frac{1}{4}$ -in. pipe were welded, equally spaced, forming a "piano hinge" (Fig. 1, 2). Two steel pins $\frac{3}{8}$ -in. diam by $7\frac{1}{2}$ in. long were used to connect the two pads.

The next link tested was of machined steel, designed to contain the cut ends of the track belts and eliminate the long pin required in the piano-hinge joint (Fig. 3, 4). Two links per section are needed for this type of joint. Each link is connected by a short pin making removal of the pin relatively easy. The existing rivet holes in the pads were enlarged and used to bolt the links to the pads.

The third link consisted of two pieces of steel machined to fit the contour of the track pads between the inner and outer track bands and connected by a standard #60 link of double-strand roller chain (Fig. 5, 6 show configuration). The links were fastened to the pads with high-strength bolts through holes drilled in the pads. Two each per joint are required for this type of link also.

The fourth link was of the same configuration as the third, but was constructed of high-strength aluminum (Fig. 5, 6). A standard #60 double-strand roller-chain link was used to connect this link also. This link was tested with two types of pinhole inserts, self-lubricating bronze and case-hardened steel.

The fifth link was designed primarily to repair a broken unsectionalized track in the field (Fig. 7, 8). It consisted of two pieces of $\frac{3}{4} \times \frac{3}{4} \times 4$ in. long steel, machined to accommodate a standard #60 single-chain link.

Test procedure

To test the track links under similar conditions, a test course 2.3 miles long, consisting of approximately 10% hard road surface, 30% snow-covered roadway, and 60% open, rolling, snow-covered terrain was selected. The course was well marked with flags, and the distance was measured with a pedometer wheel.

A standard M29C Weasel equipped with the test tracks was used for the tests. The test track was made by cutting a new weasel track into five equal sections to which the various types of connecting links were fastened. The number of sections was merely a matter of convenience. When the track is divided into five sections, each section is 50 in. long by 21 in. wide and contains 11 pads. The number of laps around the test course was recorded; as a cross-check, the mileage was read from the vehicle speedometer. The links were inspected for wear and subsequent failure after each day of testing.

Results

The piano-hinge joint was first tested on all five sections of the test track. The first deficiency was noted when some of the pins connecting the two pads sheared. The broken pins were bent because of misalignment of the hinge and were difficult to remove. The broken pins were replaced by a larger diameter pin ($7/16$ in.) and testing was resumed.

* Redesignated U. S. Army Cold Regions Research and Engineering Laboratory, 1 February 1961.



Figure 1. Piano-hinge connecting link installed on track.

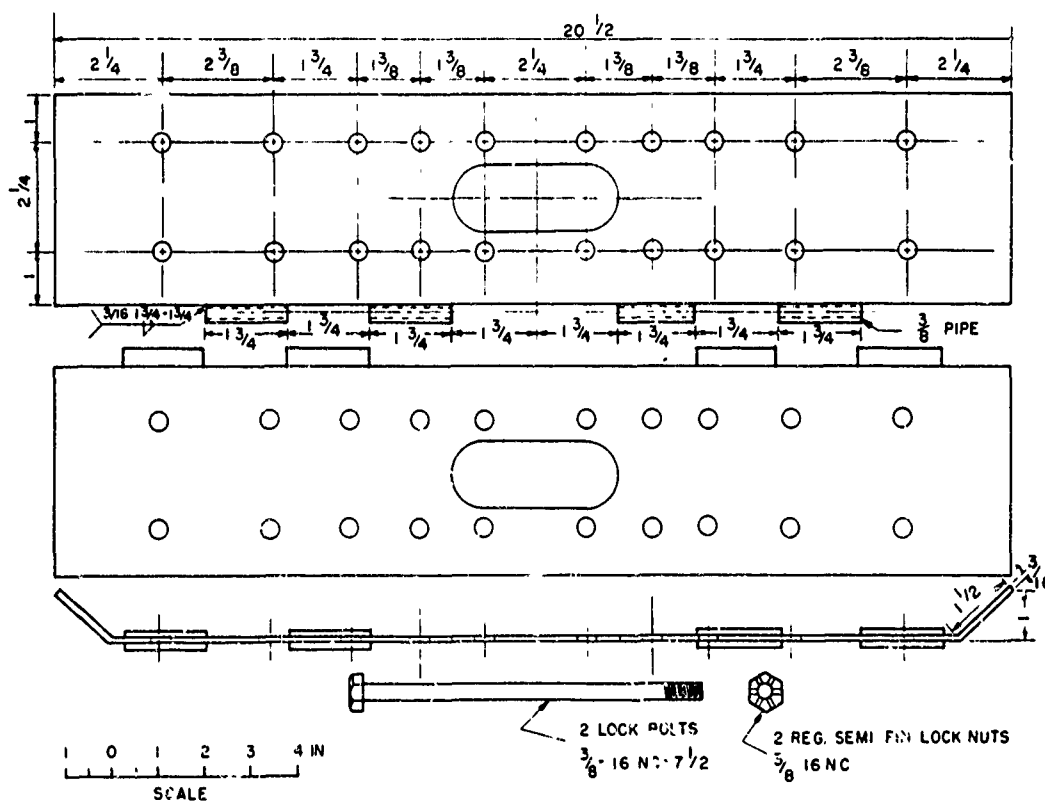


Figure 2. Design of piano-hinge link.

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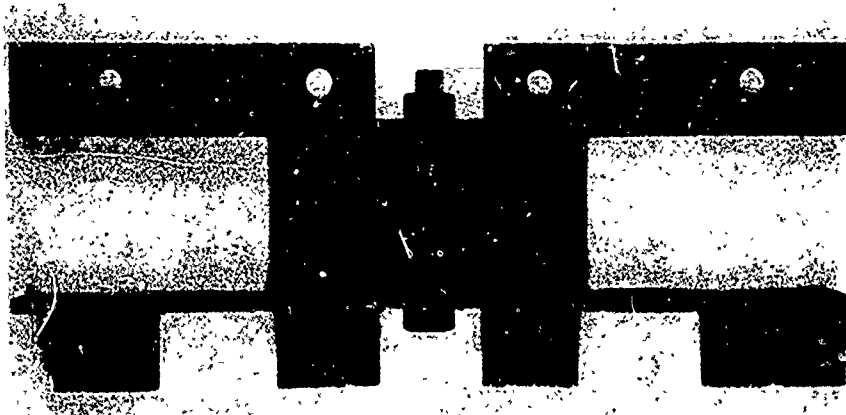


Figure 3. Connecting link of machined cold-roll steel designed to contain the cut ends of the track belts. (Bottom view).

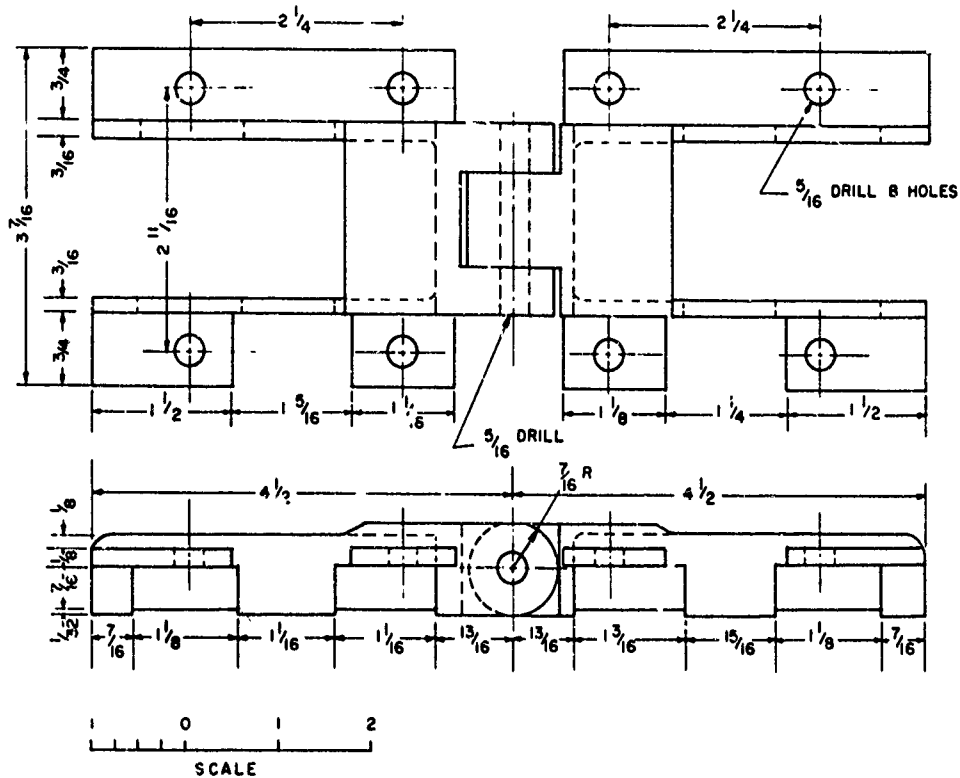


Figure 4. Design of machined cold-roll steel link.

When the pins were replaced, it was noted that sections of pipe welded to the plates to form the hinge had begun to crack. The cracking continued and frequent welding was necessary. After 100 miles, it was decided to abandon this type of connection. In addition to the high cost of fabrication and the maintenance required, this link produced a high noise level which was objectionable. Testing of this type of connection was discontinued, but one joint was retained for comparison with other types.

The machined steel link (Fig. 3, 4), with a short pin designed to contain the cut ends of the track belts, was used on four of the sections; the fifth section retained the hinge joint.

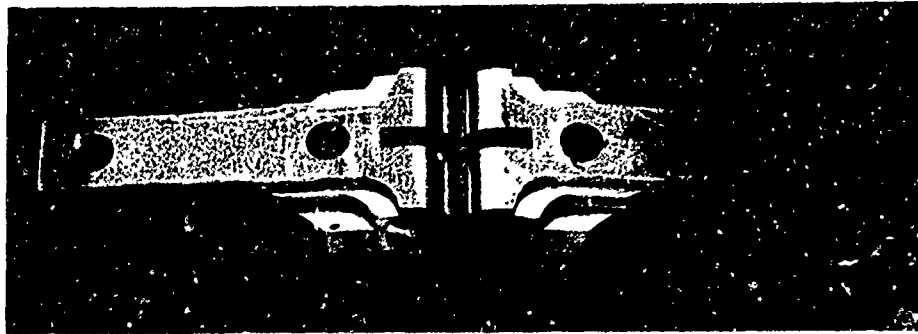


Figure 5. Aluminum connecting link with hardened steel pinhole insert utilizing a #60 double-strand roller chain link. (Bottom view).

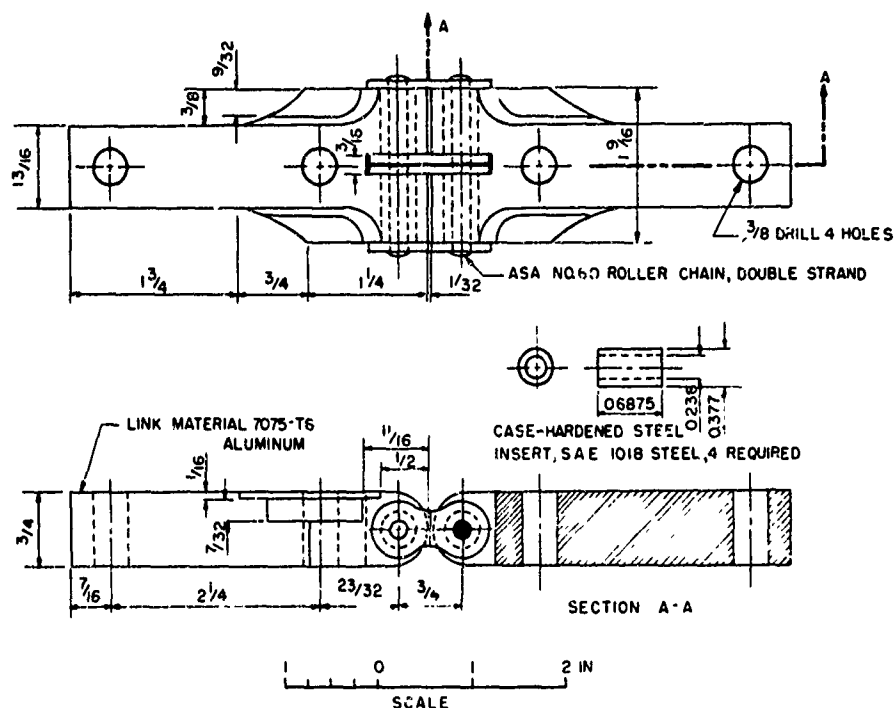


Figure 6. Design of aluminum connecting link.

After several laps around the test course (approximately 223 miles), the links showed no appreciable wear of the moving parts. However, a considerable amount of noise was produced as the links passed over the drive sprocket. Considering the objectionable noise and the high initial cost of machining the link, further testing was considered unnecessary. It was now apparent that a track connection with any of its component parts coming into contact with the drive sprocket would be objectionable because of the additional noise and vibration.

An entirely new link of the configuration shown in Figure 5 was designed and the test track was assembled with all links of this type. Links for two of the joints were machined from cold-roll steel, two joints were 2024-T4 aluminum with one joint containing a bronze insert, and the fifth joint was two links fabricated from 7075-T6 high-strength aluminum. The track was then run over the test course for 100 laps, approximately

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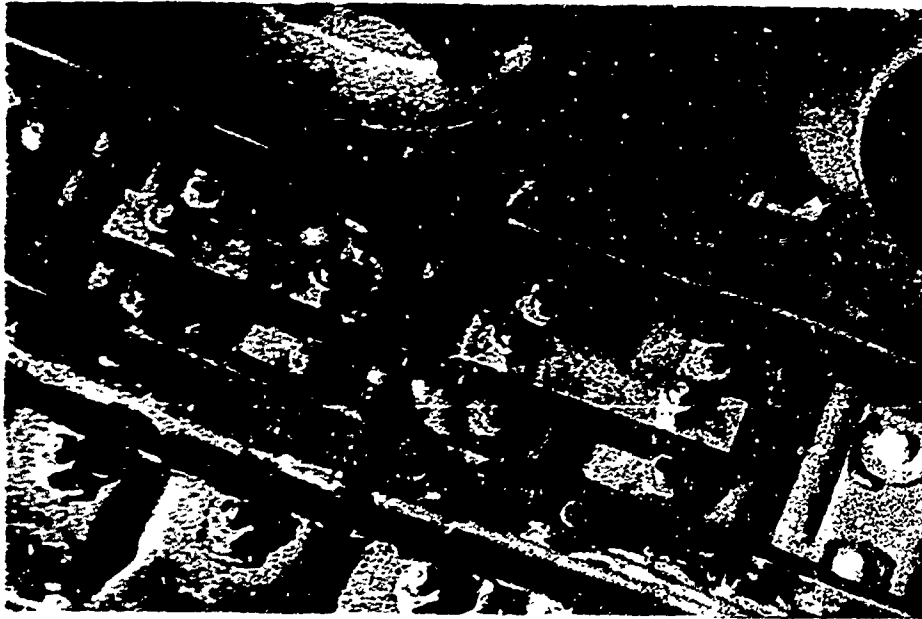


Figure 7. Connecting link designed primarily for emergency repairs of broken outer bands of tracks.

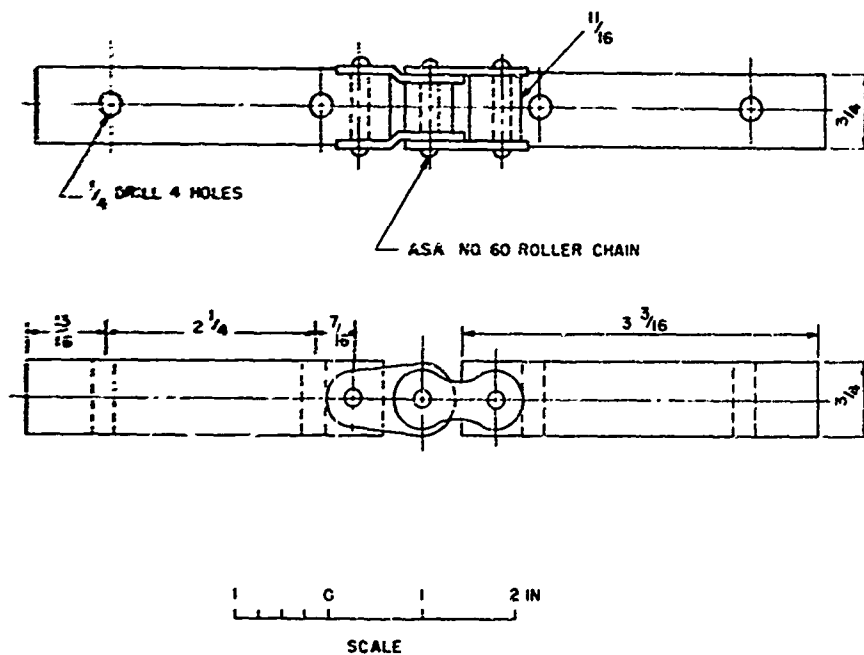


Figure 8. Design of connecting link for emergency repairs.

230 miles. The track performed satisfactorily and there was no failure of any of the links nor any increase in noise or vibration. The track was then disassembled, and the individual links were inspected for wear and possible distortion. Of the four types, the 7075-T6 high-strength aluminum link appeared to hold up the best; no visible wear or distortion was noted. The 2024-T4 aluminum link with a bronze insert was found to have excessive wear, and the pinholes were elongated. The steel link was slightly worn and slightly elongated.

The pinhole of the 7075-T6 aluminum link was then modified to accommodate a case-hardened steel insert. The purpose of the case-hardened insert was to provide the necessary wearing surface while the aluminum body absorbed the dynamic stresses.

The track was reassembled and testing resumed with two joints consisting of 7075-T6 aluminum with hardened steel inserts, two joints made up of steel links, and the fifth joint made up of a steel link (Fig. 7, 8). designed for emergency repair of the outer bands in the field. The test track was then driven for a distance of approximately 195 miles. The 7075-T6 aluminum link with the hardened steel insert had no noticeable wear or distortion and proved entirely satisfactory. The all-steel links showed no noticeable amount of further pinhole elongation.

After testing was completed, the test track was placed into regular service with three joints of steel links and two joints of 7075-T6 aluminum with hardened inserts. After more than 1200 miles of wear, the test track was still performing satisfactorily with no failure of the connecting links noted.

CONCLUSIONS

The high-strength aluminum link with a hardened steel insert (Fig. 5) proved to be the most satisfactory of the types tested. The ability of the link to absorb the high dynamic stresses without distortion, while its hardened steel pinhole insert provides a wearing surface, sustains its superiority over the other links tested.

Although the all-steel link of this same configuration received some distortion of its pinholes, many miles of satisfactory service may be obtained with these links. The cost of material and machining of the steel link is slightly less than that of the aluminum link. However, considering the slight difference in cost, the aluminum links with hardened steel inserts are probably preferable.