

taken to a high elevation. If the load is light enough, the skis well waxed, and the snow conditions favorable, there is no particular difficulty or danger involved in driving a sno-plane up one of these steep, narrow mountain roads around hairpin turns on hard drifted snow surfaces with steep side slope and grades up to 20 per cent. With the throttle wide open the plane gets enough of a lift to keep it from sliding sideways downhill on the steep side slopes. The difficulty and the danger at such places is in the descent when the propeller is idling and the totally inadequate brakes fail to hold the machine. On the one 28-mile trip of this kind made on Boise River watershed this year we made the descent hazardously. One of us rode the front ski in order to hold to a safe course. The other member of our party was at the controls but poised to jump free from the machine should it get away from us.

The Idaho State Fish and Game Department operates three sno-planes. It has tried to provide adequate brakes for its machines without success except by rough-locking the skis of the sno-plane with log chains. Our snow survey crews will avoid some difficulty and danger hereafter by stopping short of the steep country with the sno-plane and proceeding on foot.

In conclusion it may be said that the utility of the sno-plane is limited to the carrying of light loads and to topography which is not too steep and obstructed to descend safely with it.

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During the following discussion, films were shown of the various types of snow equipment.

The Chairman asked that Mr. Tucker, or one of his sons, discuss their product, the Tucker Sno-Cat, "without getting too technical."

MR. MORRIS TUCKER: Here are some pictures that will give you a general idea of the principles of the Tucker Sno-Cat, and in particular will show its flexibility on rough uneven snow surfaces.

We want to stress the fact that in our first Sno-Cats we were forced to use inferior material for the tracks. Although the best obtainable it wasn't good enough. Since then better steel has become available and we are now using alloy steels in the tracks for the Sno-Cat that are giving us 100% service. Mr. Work's report on the Sno-Cat indicates that he drove the last 500 miles without trouble whatsoever excepting a defective steering gear bearing which did not cause any delay on his trip.

The Sno-Cat somewhat resembles a caterpillar drive. The drive is an open cleated track revolving on 108 flanged ball races, without touching the wide stainless steel pontoon skis which follow the contour of the snow surface.

The heavier the load carried on this pontoon skii the greater the traction on this open link drive, the caterpillar principle carries the entire weight on the revolving track link belt.

The new Sno-Cats carry a bearing pressure on the snow of about .58 pounds per square inch and the machine is steered by two 8 inch front hickory skis with keels carrying about 30 per cent of the weight, the remainder of the 70 per cent is carried on the two drive tank pontoon skis. The new Sno-Cat has an aluminum body, weighs about 2200 pounds, and will tow its own weight, on a two runner trailer. These new Sno-Cats will have a 18 inch wide drive link equipped with a 3/4 ton Ford truck rear-end including the latest type differential lock which was developed by the government during the war this will assist greatly on side hill work and in snow pockets allowing both pontoon tracks to pull equally and automatically release. It has conventional differential action on turns. All basic patents are now being held by Tucker & Sons, Inc.. This Company is licensing the Tucker Sno-Cat Co. the exclusive manufacturing rights to build and sell Sno-Cats.

Due to our sharp increase in business we found it necessary to move our plant from Grass Valley, California to Medford, Oregon in order to be on a thoroughfare. We are now constructing a 50' x 100' concrete structure for the manufacturing of Sno-Cats. This property is located  $1\frac{1}{2}$  miles south of Medford, adjoining the Southern Pacific Railroad on the West and the 99 Highway on the East. This gives us an equal distance from Portland and San Francisco with a 12 hour service for materials.

Paget: Does this machine have a cab on it?

Tucker: Yes, a short-sleeved job. This one (indicating) weighs about 3,000 pounds. No insulated cab. A few other things increase the weight some.

Work: This particular Tucker Sno-Cat we are testing has been driven to date a distance of 568 miles on the snow. Gasoline consumption has been 189 gallons, equivalent to 3 miles per gallon. I expect we have put this machine to more severe use than other users would do, because in the snow survey work we don't travel the same beaten trail. Trips almost always are into untracked snow, over steep, rough terrain, and we seldom benefit from running in a beaten track.

Paget: You spoke of dependability of the machine. That is one thing that snow surveyors are interested in. Would they have to take skis along if they wanted to go about ten miles from the cabin late in the afternoon, or would it be better to stick pretty close to home.

Work: I will answer that this way. About two weeks ago Jim Marr and myself arrived at Belton, Montana, for the purpose of driving the machine a distance of 100 miles over the snow to Kishnahn snow course, near the Canadian boundary. The Superintendent of Glacier Park appealed to us, immediately on our arrival, to use the machine to bring out from a snow bound ranch a Canadian trapper who was desperately ill. The County had, in the meantime, initiated an effort to plow out 45 miles of road to this ranch, but was making very slow progress.

Of course, we decided that it was imperative to get the man out as quickly as possible, which we did, bringing him out in the machine, lashed to a navy basket-type stretcher, so he could be extended full length, making the round trip of 90 miles in 9 hours, 15 minutes. We had a lot of trouble with moose, too, but we had absolutely no qualms about starting out with the man, in his condition, because we felt confident we would soon have him in the hospital. We do have confidence in this machine.

Paget: Thank you, Mr. Work.

Rhodes: I would like to add, in connection with that, we had a very nice write-up about the work of the Tucker Sno-Cat on that trip, in the Kahspell paper. The people around there were grateful for what was done. I think it was called a "Sno-Go," instead of a "Sno-Cat," but it received a full column on the first page and half a column on the third page--lots of publicity.

Clyde: What happens in timber, or rocky country, when you get those pontoons on a point? Those castings on which the rollers operate, do you have any trouble with those breaking?

Work: What we have found most to be feared in the way of rocks are small rocks about the size of a large walnut. Because of the construction of the machine, these rear pontoons are, in effect, skis. The pontoons simply slide over the surface of the snow, and these grousers (indicating) which engage the snow, move around the pontoon on an endless link affair. A small rock, the size of a big walnut, caught up on the under side of one of those grousers, might crease the under side of the pontoon; but with rock of large size, such as you ordinarily encounter, the machine will ride over it. Then the danger becomes that which is experienced with any of this equipment.

Kraebel: What is the material of the pontoons?

Work: Stainless steel.

Clyde: What happens when you operate the machine in slushy snow?

Work: You get a very wet, sloshy movement.

Clyde: The pontoon, is that water-tight?

Work: Yes, it is.

Clyde: On top, how do the sprockets make contact?

Work: Through the gear box in which the sprockets run. That is not water-tight, but the gear box is separated from the pontoon by a water-tight partition.

Clyde: When the weather gets below freezing, what happens if you set it out and it freezes?

Work: Here is what did happen to us in one case. The sprocket gears became immovable. Now this machine has an extremely powerful engine--115 horsepower--and we badly damaged the rear end, because at that time we didn't appreciate that the application of power, when the sprocket gears were frozen, would do such damage.

Dr. Church said you must spank the new-born baby to make it cry. We had to spank this machine two or three times. But we fixed that by installing an exhaust heater, and we now make it a customary practice, in sub-zero temperatures, to run that exhaust heater on our return trip in the evening, and before we take the machine out in the morning. Does that answer your question?

Clyde: Yes, sir. How about small logs, windfall, stuff like that?

Work: Well, the machine resembles an eel or weasel when it goes over windfall and logs, unless they are of such height that it is quicker to cut the log

than to attempt to go around it, or to build up a little snow bridge to get the skis over.

Murphy: How about vertical banks? Can it negotiate 6 inches, a foot, 3 ft.?

Work: Well, it climbs out of these rotary plowed roads, on which the snow bank may be 4, 5 or 6 feet high. The way we do it, we just back the machine up to the bank, take a run at it, spin the track to tear down a little snow, then turn the machine around, and go right up. That was demonstrated to Mr. Rhodes.

Kraebel: You can't do any more than with skis on a vertical obstruction. You have to have slope to ascend a vertical obstruction.

Work: In a case of that sort, you have to approach the obstacle from the diagonal.

O'Brien: How about the machine tipping over?

Work: Unquestionably the machine could be tipped over. So far we have never had that experience, and, frankly, I don't know from personal experience on what percent grade the machine would tip. Mr. Tucker, I believe, has experimented with that, and he informs me the machine will travel on grades up to 35% side slope.

Clyde: The danger isn't always from tipping. You often strike a condition where the whole snow surface will slip, as in a snow slide. Another thing we have to have is the ability to get out, if caught in a situation of that kind. It is not uncommon, on side hill roads, bench cut, to have the road completely drift over. It may be only for 500 feet, but you have to cross. One of the difficulties we have is actually getting on to them. When you get into that predicament, you must just dig out of it with a shovel.

Codd: Is there any chance of the track slipping off on downhill travel?

Work: No, that is impossible.

Codd: I have seen the Tucker operated, but have never seen the tracks put on.

Work: You see, the track can't slip off because the track engages the pontoon top and bottom. You have grousers propelled around the pontoon, running in a little race of their own. They can't get off; it is impossible. One reason why the Weasel, and possibly the M-7, the T-27, all these open track machines have difficulty in navigating side slopes, is due to the fact there is nothing to prevent side slippage. In this particular machine the pontoon offers a solid face toward the snow at the side you see (indicating).

Clyde: Bill Lang, will you tell us something of your experience with that machine?

Lang: Personally, I haven't ridden in the machine yet--I haven't had an opportunity to ride in it. But I have a letter here from the boys who took it out on two trips. I thought you might enjoy hearing what they had to say about it. Neither had driven the Sno-Cat before; it was the first time they had seen it. They took the machine out for two trips of about seventeen miles. In fact, one of the boys just came to work for us the first of August; he had never made snow surveys before.