VOLVO

Presentation of

Bv 202

In 1948 the Swedish Army bought a number of Studebaker Weasels left on the battle-fields in Europe. Those surplus vehicles became very popular and were extensively used for snow operations in the north of Sweden. Difficulties in getting spare parts and sky-rocketing maintenance costs made it necessary, however, for the Army Ordnance Department to look for replacement.

In 1954 - 1956 the Ordnance Department evalueted different means to solve the problem of replacing the Weasel.

Different foreign makes of snow vehicles were bought and tested but for one reason or another they did not meet with the demands of the Swedish Army.

Early 1956 the best qualified of th Swedish industries were asked if they were interested in designing and manufacturing a tracked vehicle aimed at replacing the Weasel. Even Bolinder-Munktell were asked but we as well as all other questioned industries were not interested.

Regular farm tractors were equipped with tracks and so was a boggie of a trailer - or maybe semitrailer is a more adequate name - that was driven by a propeller shaft from the power-take-off of the tractor. This solution was an example of articulated steering and even if the entire unit did not work out to be the final solution, the principle of articulated steering in the minds of the Army Ordnance Department proved to be superior to other means for an over snow vehicle.

When evaluating the results of research performed, the Army Ordnance Department in spring 1957 decided to design a tracked over snow vehicle.

Two years later early winter 1958 two units were built and subject to tests in competition and comparison with other possible units.

The new vehicle proved superior to anything earlier tried and a series of ten more was built for further trials. Those ten were delivered early 1960. During the tests the vehicle proved so versatile and suitable for warfare in snow that its role has become much bigger than originally was planned.

Early 1961 the design was sent out to major Swedish industries for competitive bidding.

In the final selection the Volvo group was selected as vender. Within the Volvo group the entire job was delegated to Bolinder-Munktell, a wholly owned subsidiary.

In addition to the order to build the Bv 202 we also got a contract to develop the vehicle further.

This development started in November 1961 and was fully concluded in 1963, when production started and has been a tremendous work performed by our engineering department. That we say that the job has been big does not mean thatwe in any way degrade the work earlier done. The Army Ordnance Department has done a great and skilled job but it is a tough undertaking to finalize such a complicated unit in a limited time and the time they used was very limited. Also should be said that they did not know what methods would be used in manufacturing the vehicle since they did not know the vender.

Technical description

1. The vehicle consists of two tracked units joined by a link. The body of both the units is welded sheet metal.

Primarily the vehicle is designed to transport material and personnel off the road under deep snow conditions but it also can travel over dry ground as well as in mud and it also swims.

1

2. The length of the entire units is 20' 3". It weighs 6.400 lbs ready to go.

Equipped with all extra military equipment, extra fuel, spare parts and hand tools it weighs 7.100 lbs.

On the road it can be loaded with 2.200 lbs. Off the road its capacity is 1770 lbs.

This makes a GVW of 8.870 lbs off the road and 9.300 lbs on the road.

2

The cowl on top of the engine hood is to prevent snow falling from trees to enter into the body and there melt to water and maybe later again freeze to ice. The engine hood is of a balanced alligator type.

In the front of the front unit there are sturdy bumpers made of steel tubes. Also there is a guard around the muffler. The exhaust pipe ends in the left forward corner of the front unit.

The driver's compartment has room for one passenger beside the driver. The compartment is heated and also isolated from noise and heat from the engine and transmissions with help of aluminium sheets covering a 1" thick compressed layer of mineral wool-Rockwool.

The wind-screen can be opened entirely for better sight when driving under black-out conditions.

The bottom of the rear unit is omega-shaped giving good sitting space for 8 - 10 men. The rear unit is covered by a tarpaulin on a frame of steel tubes. Above the tarpaulin there is a rack for skies and other equipment.

The total loading volume in the rear unit within the limitations of the bottom and the tarpaulin frame is 153 cubicfeet.

3. The width of the vehicle is 5' 9" and its height is 6' 8".

3

4. In this view from the right hand side you see the air intake to the heater and also the connections for the engine heater which is fueled by kerosene. Every Bv 202 is equipped with one heater. Without the heater the engine safely starts at temperatures down to -26°C if the right engine oil is being used and everything else is O.K. For yet lower temperatures the heater is being used.

5. The engine in the Bv 202 is basically the same one as is used in the cars built by Volvo i.e. the B20 engine. This engine, however, is slightly modified due to the fact that in this vehicle the average horsepower output will not be far from 100 % and also because of the fact that the fuel used by the Army has a low octane number. The modifications are:

1. Compression ratio 8.7 :1
2. Lead-bronze bearings all around, that is the main bearings and the ones for the connecting rods.
3. Extra deep and high capacity of the oil sump.
4. Rpm governor.
5. Forced crank-case ventilation
6. Four blade fan.
7. Dual carburators - used on P 1800.
8. Oil cooler - used on P 1800.

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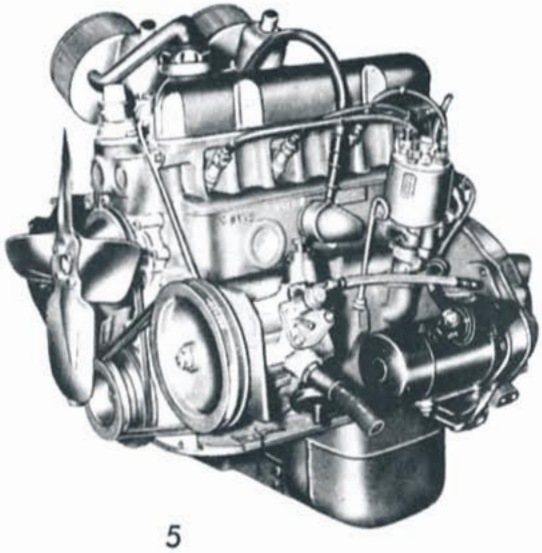

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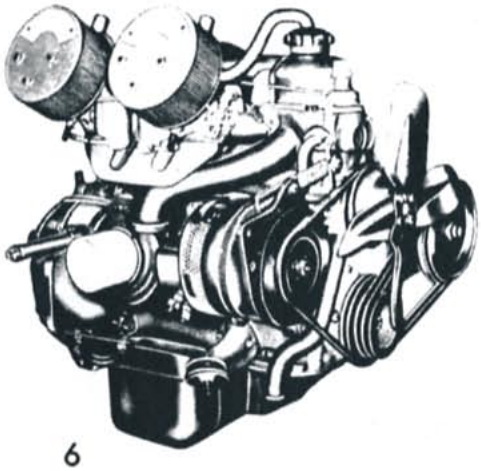

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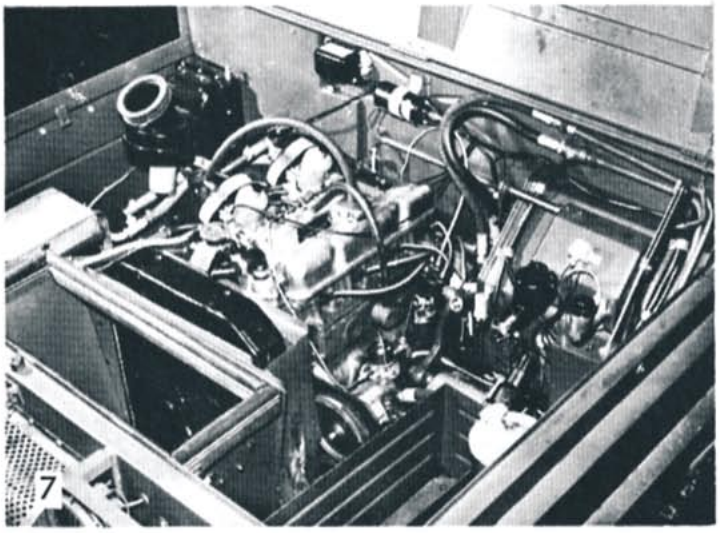
6. Engine displacement is 122 cubicinches and it developes 100 hp at 5.300 rpm SAE. The maximum torque is 108 lbsft at 3.500 rpm. Here you see the two carburators, the oil cooler and the extra shroud on the generator, serving as both a shield against radiated heat from the exhaust manifold as well as also a baffle to lead the air into the generator for cooling.



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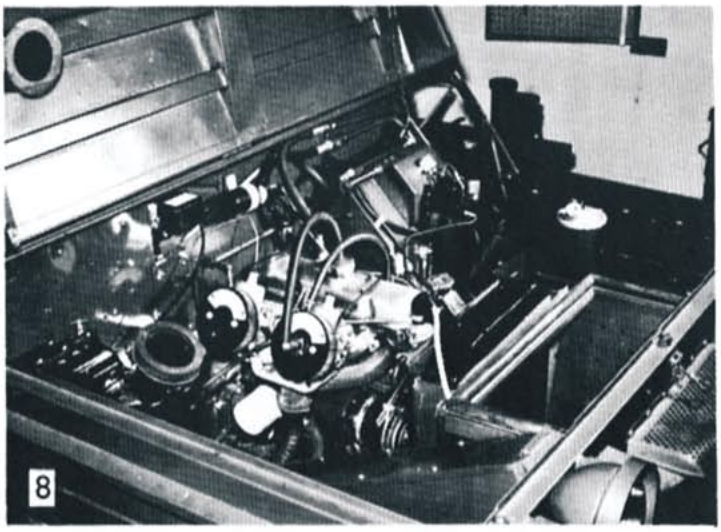
7. The engine installed in its compartment is easily accessible. Also in this picture are seen the heater with its sealing ring, the master cylinder, for the hydraulically actuated brake, the on the engine installed hydraulic pump for the power steering as well as the regular automotive steering gear and radiator.

8. This picture shows about the same things from another angle.



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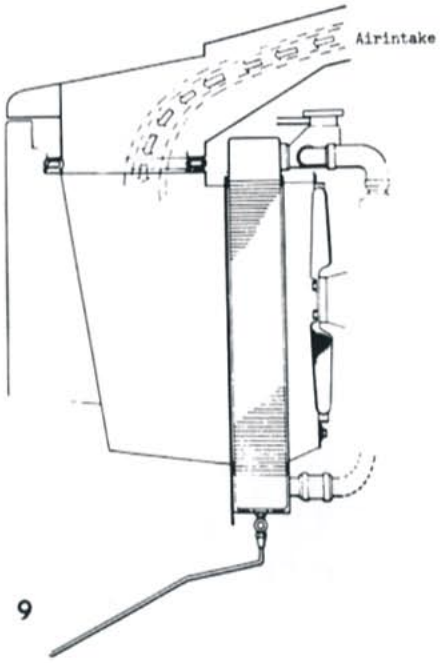
9. The engine is water cooled by means of a regular automative system but due to the encased installation of the engine and the transmissions the radiator has to have considerably higher cooling capacity than its automotive counter-part.



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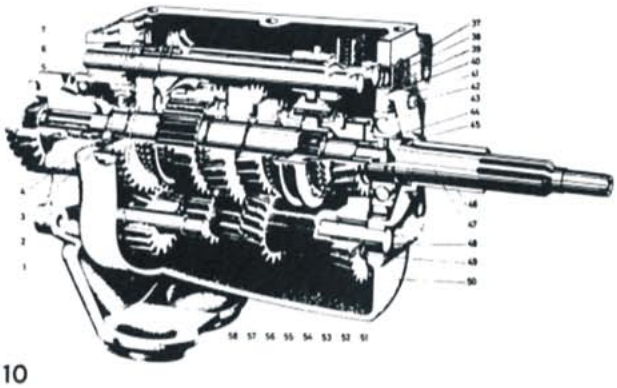
Water from this radiator also cools the oil in the two oil coolers, one on the engine and the other for the transmission oil, installed in the hull in the neighbourhood of the transmission. Those two oil coolers are identical. The engine oil is of course circulated by means of the oil pressure generated in the captive oil pump, but for the circulation of the transmission oil a special pump has been installed on the transfer case.

10. The clutch which in the line of power precedes the transmission is a 8 1/2" single dry one, mechanically released.

The transmission is a modified version of the four speed fully syncronised transmission used in Volvo cars. A regular automotive transmission is not dimensioned to take full engine power in the low gears for more than quite a small percentage of the total time used. The Bv 202 puts totally different demands on the transmission since at least in off the road driving the two low gears will be used as much as the third and fourth ones. In order to prevent expected failures in the low gears the moduluses of the gears were changed and also the ratios were altered in order to lower the demands on the low gears. In some of the critical parts lifeexpectancy was increased nine times by those alterations.



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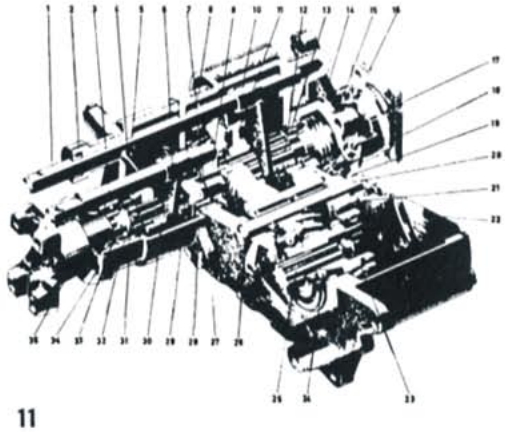

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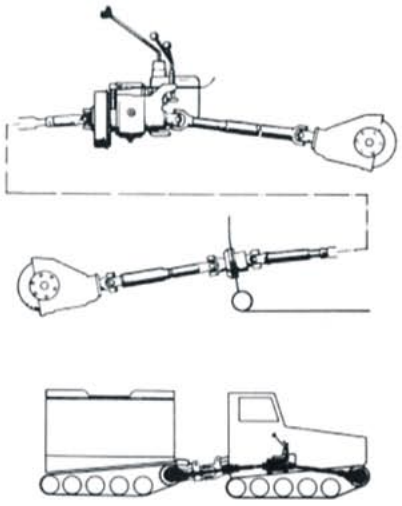
11. The transfer transmission is almost identical to the one used in the Volvo jeep i.e. it reminds very much about the one originally designed for the Willys Jeep. It has high and low gear 1.36:1 and 3.25:1 Where there usually is possible to install a power-take-off, in the Bv 202 is installed the oil pump for the circulation of the oil for both the transmissions through the oil cooler.



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12. From the transfer case power is transmitted by propeller shafts to automotive type of axels located in the front of each unit. Because of the design of the transfer transmission it is possible to disengage the power to the axle in the front unit but that is not recommended in any way. The stresses on the rear branch of the power line then become unnecessary high and the steering of the vehicle is not as stable as when both units are driven.

The rear branch of the power line consists of two propeller shafts one from the transfer case to the intermediate bearing and one between the intermediate bearing and the rear axle. The latter shaft is located inside the steering link.

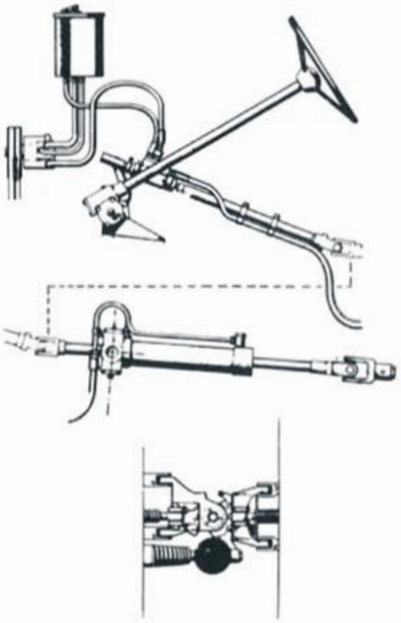
The brake is an internal drum-brake acting on the rear companion flange of the transfer transmission. The requirements of the Ordnance Department were that four consecutive brake applications with intervals less than one minut could be made at an average deceleration of 0.3 g without the brake capacity decreasing more than 20 %.

The outside of the brake-drum is made as an impeller and above the wings is a shroud which allows air to enter into the centre and be thrown out at the periphery. With this cooling arrangement the requirements of the Ordnance Department are managed with flying colours since maximum deceleration at cool brakes is above 0.6 g and at seven repeated brakings according to the requirements of the Ordnance Department the deceleration never goes below 0.35 g.

13. As was said, the axles in front of each unit are regular automotive axles, thus you do not find any type of steering system incorporated in the axles.

The vehicle steers when there is an angle horisontally between the two units. The point of the angle is in the centre of the steering link. This angle is initiated and controlled by means of a regular automotive steering gear that with the help of a hydraulic servo arrangement transforms the turns of the steering wheel into pulling or pushing movement on the arm extended to the left of the rear part of the link.

The link between the two units has three degrees of free movement - like all other freedom however - even these ones have their limitations:



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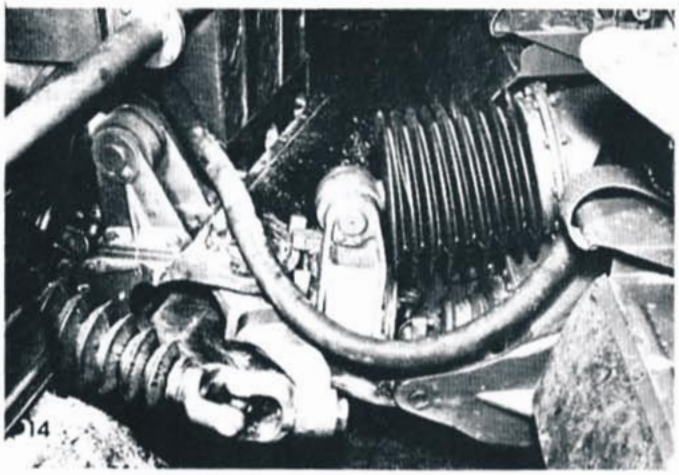
A. Each of the units can tilt vertically 17.5° up or down in relation to the link that is a total angle of 35° between the two units is allowed by the link. For the front unit the movement is entirely free except for the last 20 % of the movement when it is dampened and stopped by rubber springs. For the rear unit the movement has the gradual resistance of a double acting rubber spring to overcome. This latter arrangement was necessary in order to dampen vertical vibrations in the unit when driving on certain types of roads.

   The fact that the link for the vertical movement is two joints also allows the two units to run at levels differing up to 7 inches.

B. For steering, the link allows the units to deviate 35° to either side. Simple mechanical stops are incorporated in the design of the link.

C. The two units also can tilt 35° sidewise in relation to each other around the longitudanal axle. Also this movement is limited by a simple mechanical arrangement consisting of a tongue protruding and moving into an arc.



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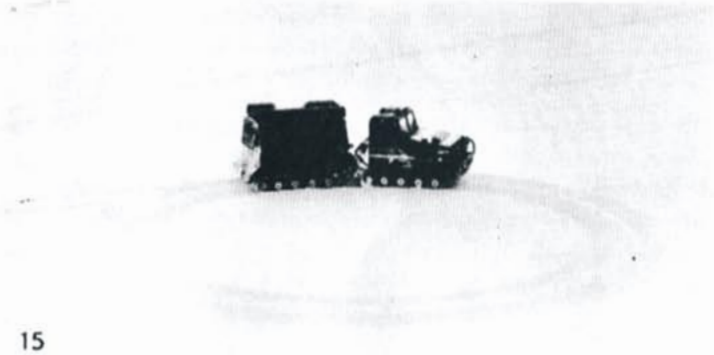
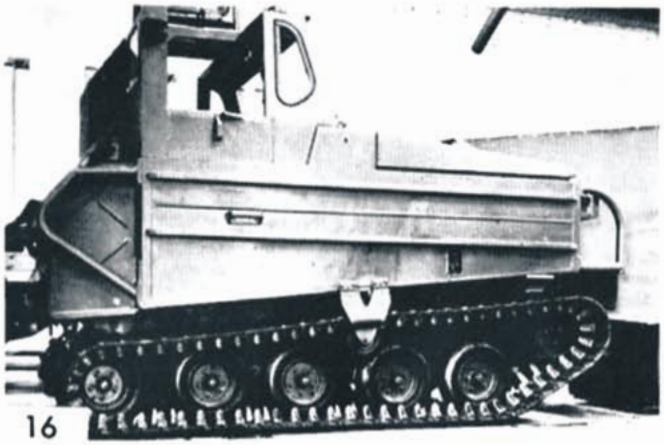
14. For water-tightness the rubber springs are enclosed behind rubber bellows.



15. The maximum angle of 35° gives a turning radius of 22' 4".



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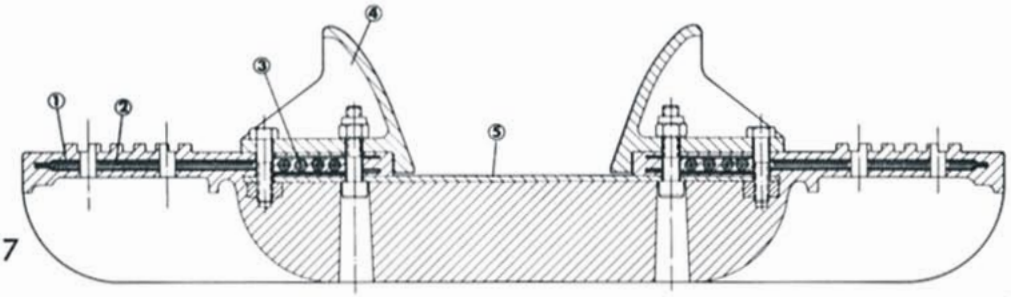
16. On the axle-shafts are attached the sprockets. A sprocket is a steel-drum on which is moulded rubber, shaped as a gear. The rubber teeth engage into the tracks and thus pulling power is transmitted.

17. The tracks consist of 1/2 inch thick rubber belts reinforced by 1/4 inch diameter stainless steel wire. It is moulded in one piece- a so called "full rubber" track, with steel bars moulded in as holders for the guide horns. The rubber makes the vehicle suitable to drive also on paved streets.



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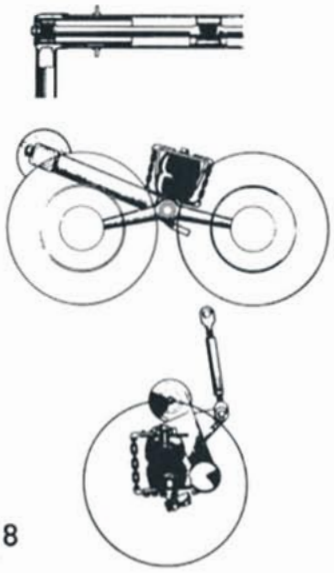

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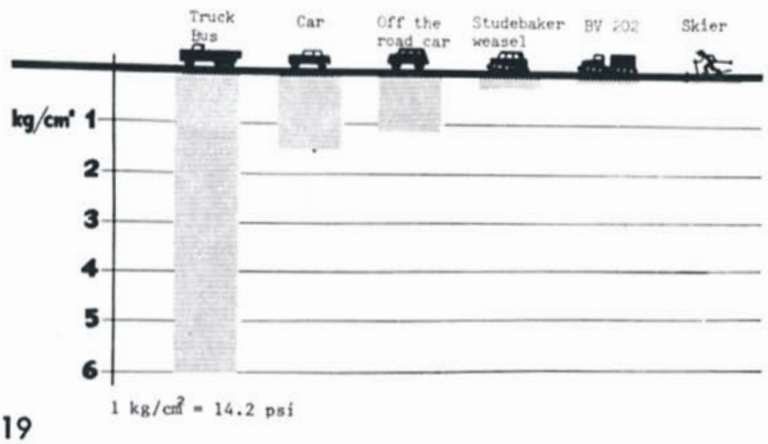
18. Torsional bars on each side support four of the wheels by means of a boggie arrangement.

There are four torsional bars for the eight boggies, that is each bar takes care of one boggie on each side of the vehicle. The cylindrical bars are by serrations fixed to the centre of the tube which also contains bushings allowing the arms to turn. In the heads of the torque arms are also serrations for the outer ends of the torsional bars. Longitudinally the arms are secured by a screw threaded into the end of the torsional bar.

In the bottom end of the torque arm is a stub around which the boggie arm turns on bushings. The front boggies of either unit are heavier loaded than the rear one since they take the first shocks when passing a bump. To assist the torsional springs against this there is a rubber helper spring at each front boggie.

Two by two makes four but there are five suspension wheels on each side of each unit. The fifth wheel is the rear one and it has it's own rubber spring suspension since it is also used for tensioning the tracks. By shortening, for instance, the left and right hand threaded rod the tensioning arm moves backwards and with it the wheel and thus the track is being tensioned.



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19. The ground pressure has to be low for the Bv 202 to qualify as an over-snow vehicle.

A regular truck exerts 90 - 100 psi, a car 20 - 30 psi. An off the road car with liberally dimensioned tires exerts around 15 psi.

The Studebaker Weasel gave a pressure of between 2 and 3 psi depending on use and load.

The Bv 202 exerts a ground pressure of 1.2 psi which is quite close to an ordinary skier who develops a pressure of 0.85 - 0.90 psi.

20. The ratio combinations are chosen to give the tractive effort as is shown on this chart as a function of speed.

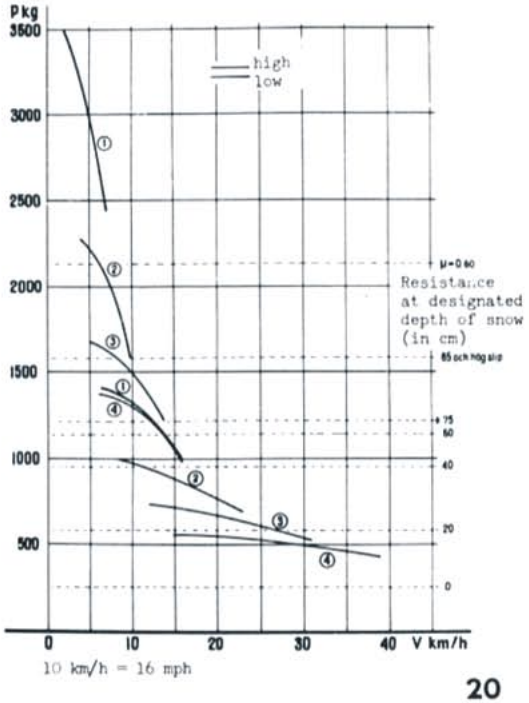
Maximum tractive effort on the lowest gear is 7700 lb that is, the vehicle could pull itself vertically upwards if friction, carburator and engine lubrication so allowed. Now, however, the carburator and the engine lubrication set the limit at 30° that is 58 %.

In the chart are also lines indicating the necessary pulling power at different depths of snow.

At level snow-free ground the resistance is 250 kg that is just above 500 lbs and you utilize only about 60 % of available power at top speed 25 miles per hour.

Above 25 inches depth of this kind of snow the conditions do not grow worse and third and fourth gear in low can be used.

Max. tractive effort in different depths of snow.



10 km/h = 16 mph

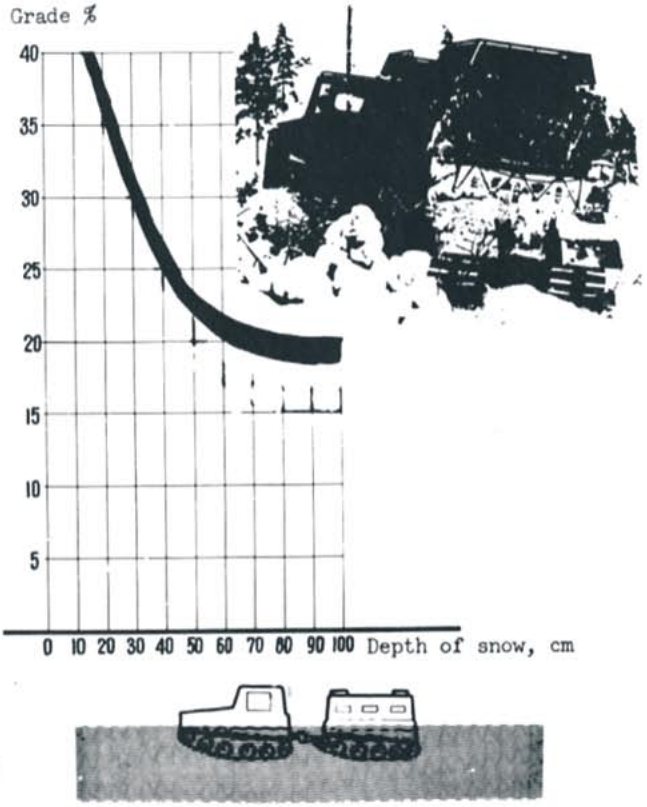
21. Power is available as we saw but in deep snow that is not enough. The vehicle has to find grip for it's tracks in order to negotiate slopes.

The gradeability as a function of snow depths is shown in this picture.

At ten inches depth gradeability is 33 % and at 25 inches and above it is approx. 20% depending on the type of snow (dry, wet, a. s. o.)

Gradeability in
different depths of snow

Load 800 kg:s = 1769 lbs



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22. The vehicle floats when fully loaded. If the rear is unloaded it floats higher up. Maximum speed in water is approv. 2.1 miles per hour.

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Specification Bv 202, Mark II

Weight	2.900 kg (6.400 lbs.)
Weight with extra fuel, hand tools and spare parts	3.200 kg (7.100 lbs.)
Load on road	1.000 kg (2.200 lbs.)
Load off the road	800 kg (1.770 lbs.)
Maximum width	1.760 mm (5' 9")
Maximum height	2.030 mm (6' 8")
Length	6.175 mm (20' 3")
Clearance	300 mm (1')
Turning radius	6,8 m (22' 4")
Ground pressure	85 g/cm^2 (1.2 psi)
Engine	Volvo, type B 20 - 496912
Displacement	1,99 l (122 cv. in)
Compression ratio	8.7:1
Power/rpm	100hp/5300
Torque/rpm	15 kpm/3500 (108 lbs. ft)
Clutch	Dry, single, 8 1/2"
Clutch release	Mechanic
Transmission	Volvo M 400
Transmission ratios	1 2,43:1
	2 1.77:1
	3 1.28:1
	4 1 :1
	Reverse 2.74:1
Transfer transmission	Volvo G5
" " ratios	High: 1.36:1
	Low: 3.25:1
Axles	Salisbury 5 HA
Axle ratio	6,38:1
Maximum speed at 5.300 rpm	39 km/h (25 mph)
Steering	Automotive type with hydraulic servo
Brakes	Foot brake: Hydraulic drum brake acting on propeller shafts
	Hand brake: Mechanical drum brake

BOLINDER-MUNKTELL

– a member of the Volvo Corporation,
Eskilstuna, Sweden