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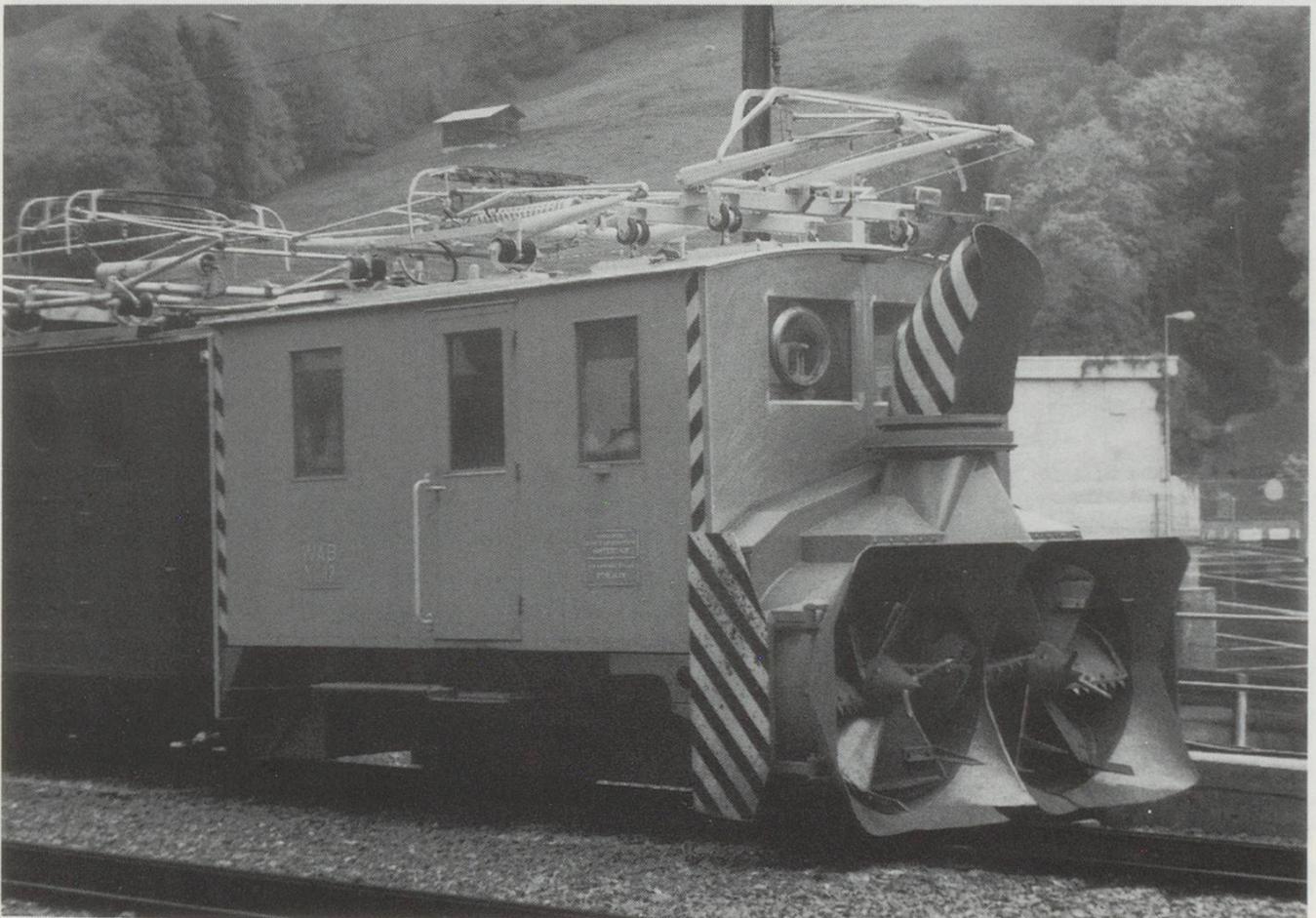
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SNOW FIGHTING ON SWITZERLAND'S RAILWAYS. PART 2.

By A.E. Hauser-Gubser.

For our members who missed the first part of this article, I am dealing again with some facts about the winters in my country :-

1. In general, snow falls are more or less regular. Special meteorological conditions, however, may lead to very heavy snow falls in a few hours causing traffic interruptions if the snow is not removed or even worse, acute avalanche danger if the fallen snow has no opportunity to set down properly during a long period of cold.
2. The quantity of snow or snow depths vary considerably depending on altitudes, the prevailing winds and the geographical locations. As a rule it can be said that the southern slopes of the Alps have in general higher snow depths than the northern side.
3. A network of weather stations and observing posts is daily informing the National Institute of Snow and Avalanche Research at Weissfluhjoch above Davos. This Institute issues a daily bulletin which is of great use for the ski tourist, but its detailed forecast together with reports along the railway line help the railway authorities to take the correct decisions for fighting the snow.
4. To prevent damage on the railway lines or traffic interruptions, the railways dispose of the problem by various means. One of the most important is the growing of protective forests, where this is possible, because forests not only withhold the thin humus layer and so prevent the soil washing out, but they protect also against the wind and the much feared snow drifts.



W.A.B. Twin rotary snow plough. Xrote No.12 at Lauterbrunnen.

Photo: R. Oliver.

I may add that snow drifts and snow slides can pose considerable problems. Snow drifts on the Bernina Pass have attained depths of more than 7.5 metres. Snow slides usually carry with them stones, earth and timber which have to be removed **before** the rotary snow plough can be put to work. It often happens that once the line has been cleared, a second slide comes down at the same spot and the entire task has to be done again.



Rh.B. ABe4/4 No.48 battling the summer snow on the Bernina Line. Photo: P. Over.

Removing snow can also be pretty dangerous and each mountain railway can report its share of accidents, some of them very spectacular. In some of them, excellent

railwaymen lost their lives. If some of our members once walked down from Alp Grüm along the Bernina line, they may note the commemorative plaques for the men who died in such accidents. Removing and fighting snow is also a very costly affair. The Furka Oberalp Bahn reported that the re-opening of the section Realp - Oberwald before the basis tunnel was completed, cost the railway between SFr.300,000 and SFr.500,000 each year depending upon the depth of the snow.

Therefore, all mountain railways do everything possible to protect their lines. During recent years, the expression 'wintersicher' has been found in the railway press, which means that a line is entirely safe in winter. Let me tell you that there is **NO** such line. To make a line 'wintersicher' you would have to protect it in its entirety by the building of galleries and tunnels. This is, of course, impossible. There are sections, where the topographical conditions of the area (steepness of the slopes, no forests and deep ravines, etc) together with the meteorological conditions produce one or even several avalanches each winter. To protect these areas is relatively easy.

However, special meteorological conditions, such as heavy snowfalls at a certain spot and mild weather may cause an avalanche to come down on spots where for centuries no avalanche has been reported. The destructive force may be such that even the forest may be destroyed. there is one rule to observe :- in the mountains nothing is secure, so utmost prudence must be observed, especially when a tourist is using routes which are seldom used. On the other hand, mountain railways have such an excellent observation service that it is today seldom that a train is surprised by an avalanche and travelling on the railway lines is quite safe today, much safer in any case than on the roads.

In the battle which is fought over and over again each winter, I would distinguish between what I would call preventative measures and active snow fighting.

PREVENTATIVE MEASURES :

To these I count the erection and amelioration of existing avalanche galleries, the erection and amelioration of avalanche protection high up in the mountains. For the latter you have good examples at Andermatt when looking North-East to the Oberalp Pass or on the B.L.S. South Ramp near Ausserberg or Goppenstein. A preventative measure is also the building of walls to steer the avalanche or snow slide in a certain direction where it can do no harm to the railway line. Also the firing down of avalanches **before** they can do damage, such as the famous 'FAT MARIANNE' avalanche of the Rh.B. Bernina Line. The firing down is done by mortars and personnel of the railway are instructed in this art. The shots have to be placed in such a way that the snow is breaking at the weakest point or line, sliding down harmlessly in the avalanche protection or ravine. It needs experienced mountaineers for this kind of work.

Besides the growing of forests already mentioned, the relocating of certain sections of the line is also a preventative measure. On the Bernina Line, some sections of tracks have been laid above ground into the wind which helps in this way to keep the track free of snow. In the same category is to be counted the automatic signal warning system on the B.L.S. which sets signals to Red when an avalanche is going down.

The most important measure is still the linesman patrolling the line and reporting each dangerous sign by line telephone. There are few passengers riding in the comfortable warmth of a modern passenger coach realising what the linesman, of which they may catch a brief glimpse through a frozen window, is doing for their safety, and this on every day. Imagine the section from Goppenstein to Ausserberg on the B.L.S., observing the slopes, estimating whether the snow will hold, controlling the rail and points, walking through the cold dank tunnels with their heavy icy winds, standing in the niches when the passenger and freight trains speed on their way. It is a dangerous job and I often wonder that the railway companies still find men doing it carefully.

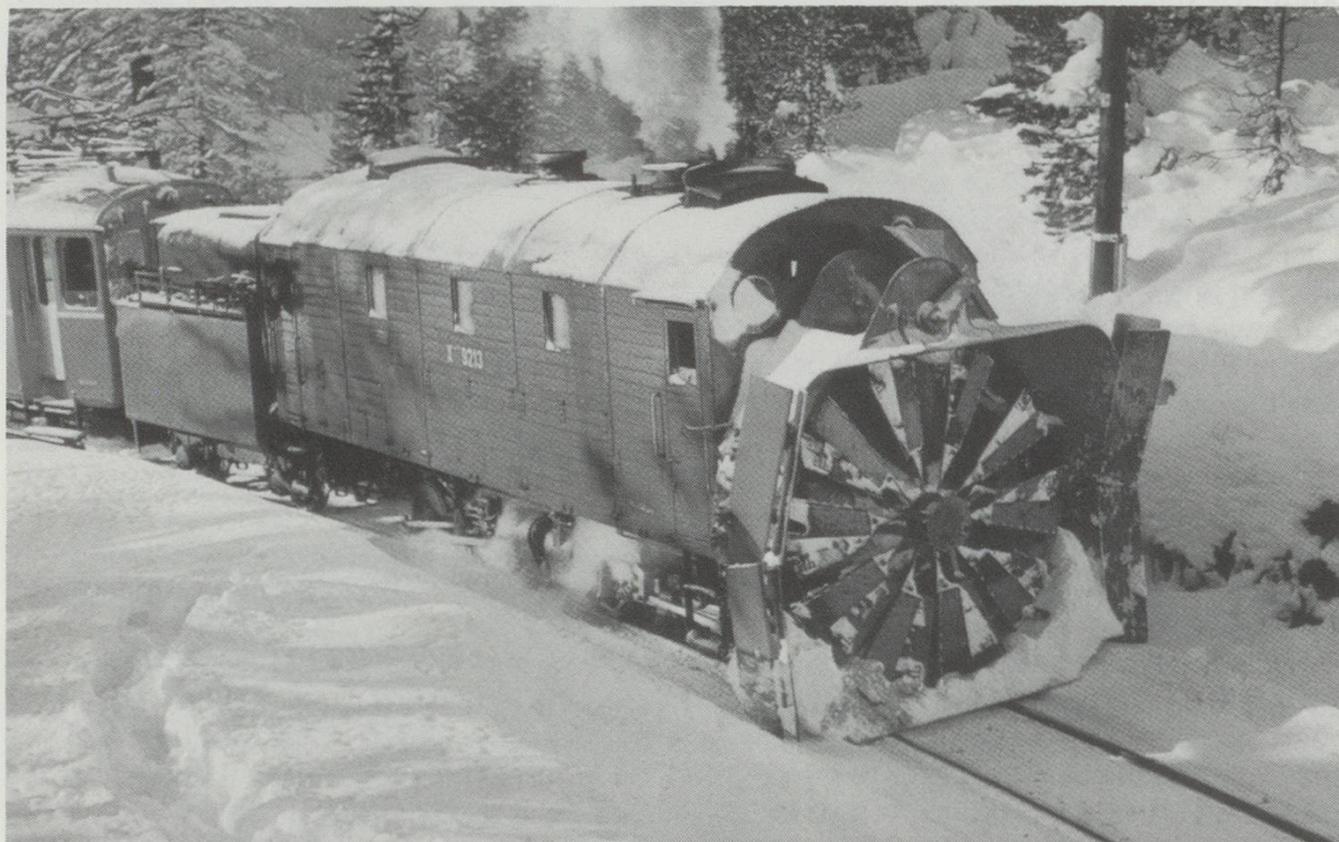
ACTIVE SNOW FIGHTING:

This is done today with sophisticated equipment, such as rotary snow ploughs, flangers,

snow ploughs, Propane gas or electric point heaters. Last, but not least, there remains the good old broom and shovel. A great help in the battle is the relatively great density of trains, because the reamers on the locomotives and electrical motor coaches do a pretty good job of keeping the lines clear.

However, there comes a point where the snow is building up between the rails and just near the rails making necessary the use of flangers and snow ploughs. As a rule it can be said that modern flangers are pushed by a motor van, say from Poschiavo to Ospizio Bernina. The flanger frees the track from snow between the rails to a depth of 45mm below rail top. The flanges on the flanger can be controlled hydraulically from the engineer's cab. This work is very important to prevent the possible climbing of the wheel on the hard pressed snow on the top of the rail and causing derailment.

Up to a snow depth of 50cms., snow ploughs mounted on the locomotive or reamers are sufficient for removing the snow. Up to 100cms., snow ploughs pushed by locomotives are being used. However this method has the disadvantage that the snow is building into a wall relatively near the track even if the snow plough is wide. As you will realize, the angle of the plough to the track axis has to be kept as low as possible to ensure a rapid flow of snow along the flanks. The longer the snow plough, the heavier it is and the greater is the power required to propel it through the snow.



Rh.B. (Bernina) Steam Rotary Snow plough.

Photo: Minirex AG. Luzern.

The sole, efficient means to remove the snow is the **Rotary snow plough** of which several types are known today. For many years, steam operated rotary snow ploughs with one rotary wheel were used on the mountain lines. On the Gotthard and Lötschberg lines they were pushed by either steam locomotives or later by a diesel locomotive. They proved to be quite excellent in design and operation. The Gotthard Rotary Snow plough X^{rot} No.100, built by Henschel in 1896 was in service until 1980, when it was donated to the Schweizerische Verkehrshaus in Luzern. On the Bernina line there are two self propelled steam operated rotary snow ploughs, X^{rot} Nos.9213-9214, built in 1911 by S.L.M. to the

Meyer Mallet principal with a wheel arrangement of 0-6-0 + 0-6-0, which are still in service today. These rotaries are still called upon when all other equipment is committed and urgent and special situations make their use necessary.

The single wheel rotary snow plough has been relieved, during the World War II and thereafter, by the two wheel rotary. The smaller wheel diameters have the advantage of much higher circumferential speeds, in this way allowing a substantially higher removing capacity. Furthermore, modern rotaries are equipped with pre-cutters; these are rotating knives cutting into the snow to use the full absorption capacity of the wheels. Removing capacity depends upon the condition of the snow. Fresh fallen snow is usually highly porous and therefore contains much air. It has the weight of 80 (very dry) to 150 (moderately dry) kg/m³. Ice, i.e. compact frozen water, has a weight of about 900 kg/m³. Between these extremes of very light fresh dry snow and ice, there is every possible condition of snow, older snow, snow having absorbed small or higher quantities of molten snow, snow which has recrystallized under changing weather conditions (cold-warm-cold), wet and heavy snow near the melting point.

What can be removed may even change from one section of track to another. Under very favourable conditions, i.e. fresh fallen snow and very dry cold weather, a modern rotary snow plough removes up to 25 tonnes on standard gauge, or 20 tonnes on metre-gauge, per minute. However, this very impressive amount can drop to 5 - 7 tonnes in hard snow or snow of slides with stones and timber which has to be cleared first. Therefore, railways tend to use their rotaries in snow not older than a few hours. On the other hand, the sortie of the rotary must not be too early, because a second or even a third sweep may be necessary, causing considerably more costs than anticipated. snow removing and the exact timing of the rotary sorties is a tricky business requiring much experience from all concerned.

During the past ten years, all important mountain railways have modernized their snow fighting fleet equipment considerably. Both diesel-electric and electric rotary snow ploughs, either being pushed or working as a self propelled unit have been acquired. They allow the snow removal with less personnel than with steam operated rotaries, which are therefore in reserve. Whenever possible, rotary snow ploughs operate with the wind and they throw the snow downhill to stop it being blown back onto the track again by the winds.

On the Bernina line of the Rhätische Bahn, a special procedure is sometimes used to remove the snow in which are involved usually two snow clearing trains. The first, composed of say, electric snow plough X^{rot et} No.9218 powered and propelled by a dual powered locomotive Gem4/4 No.810 and a reamer vehicle No.X9132 opens a snow channel of three metres width which is then widened to a maximum of 6 metres by the barn door like flanges of the reamer vehicle. The latter is throwing the snow onto the centre of the track again. Immediately behind the first train, the second rotary X^{rot et} No.9219 propelled by Gem4/4 No.802 is following removing the snow from the track. The purpose of this practice is to obtain a wide channel of snow which cannot easily be filled in again by drifting snow and therefore can be rapidly cleared again.

Sometime the snow is too deep even for the rotary unit to remove. In such cases, the snow depth is first reduced with rotaries on a caterpillar like framework down to an acceptable depth. This requires of course, much more time. On the Furka Oberalp Bahn, this was standard procedure when re-opening the Realp - Oberwald section in the spring.

When the rotary wheels are damaged by stones or timber in the snow, it is necessary to repair the wheel on the spot. Not an easy task when it is minus 20°C or when a raging blizzard covers your toolbox in a few instants with a thick layer of snow. During many years and by acquiring great experience, snow fighting on Switzerland's railways has reached today an extremely high standard which is the very necessary guarantee for a safe journey over the mountain lines in winter.



F.O. HGe4/4 No. 37 at Disentis with Glacier Express.



RhB. Triebwagen ABe4/4 No.48 approaching Alp Grüm on the Bernina Line.