

## Innovative catenary installation technology applied on German Rail

Since February 2003, within the framework of a large-scale contact wire renewal programme, DB Bahnbaubau GmbH, a subsidiary of DB Netz AG, has been using the new Plasser & Theurer FUM 100.128 catenary renewal machine on German Rail (DB AG). Using this new machine and its ancillary vehicles, the contact wire and carrying cable can be installed, in a single working pass, with the final operating tension and in the correct stagger. Thus, compared to using conventional technology, a 50% reduction in track possessions and, moreover, a reduction in costs can be achieved.

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Inspections of overhead lines that have been carried out on German Rail (DB AG) have shown that, in the coming years, renewal of contact wires will be required on a large scale, which cannot be handled using conventional methods alone.

Thus, the Catenary Division of DB Bahnbaubau GmbH, which has been active and, thus, gained extensive experience in the field of renewal and upgrading of catenary systems, especially on DB AG, for some 10 years now, has been seeking a technology that would guarantee a cost-effective, efficient and high-quality exchange of contact wires, whilst ensuring high line availability.

After thorough investigations, DB Bahnbaubau GmbH opted for the FUM 100.128 catenary renewal machine (Fig. 1) which, in a single working pass, can install contact wire and carrying cable immediately with the final operating tension and in the correct stagger. DB Bahnbaubau GmbH believes that this new machine, as the core of its catenary renewal train, meets today's modern demands with respect to the replacement of overhead lines. Specially developed and adapted for conditions on DB AG, the FUM 100.128 catenary renewal machine has been in operation in Germany since February 2003.



Fig. 1: The FUM 100.128 catenary renewal machine of DB Bahnbaubau GmbH

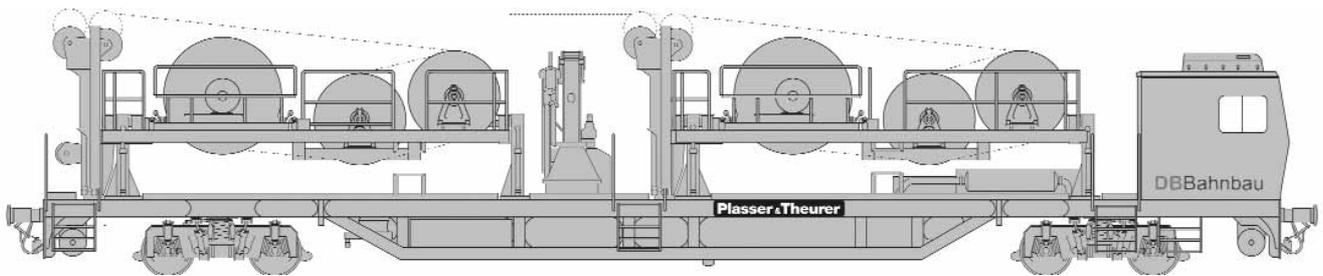


Fig. 2: Diagram of the FUM 100.128 catenary renewal machine, which features a driver's cab, two tilting winch units and underfloor drive units

### The FUM 100.128 catenary renewal machine (Fig. 2)

The FUM 100.128 has some specific design features. For instance, the diesel engine and the hydraulic plant with associated ancillary units are located underfloor. Further, the undercarriage features two two-axled bogies. During work operation of the machine, each of the four axles is driven hydrostatically, thus guaranteeing smooth starting and accelerating.

On the vehicle frame, two almost identical and independently operating winch units are located that can be tilted in the horizontal plane crosswise to the track (see Fig. 3).



Fig. 3: Winch unit in tilted position

The wire/cable storage drum on each of the two winch units is mounted on laterally displaceable frames, which ensures that the contact wires and carrying cables are always guided in a straight line. Friction winches enable stepless adjustment of the final operating tension to between 8 and 28 kN.

Each electronically-controlled winch unit is equipped with a telescopic lifting mast which, using guide rollers, regulates the required installation height and lateral position of carrying cable or contact wire and thus, immediately during installation, the staggered suspension required is produced.

In the middle of the machine, a loading crane is positioned that is used for loading and unloading the wire/cable storage drums.

The FUM 100.128 catenary renewal machine features an air-conditioned cabin that houses a driver's control desk, four seats and a cabinet housing the computer unit for controlling the machine operations. The machine can also be operated by remote control.

### Work method

The catenary renewal train working on DB AG, into which the FUM 100.128 is incorporated during operation, embraces (see also Figs. 4 and 5):

- a *dismantling unit*, comprising a trackwork vehicle with elevating work platform and a drum wagon, which are used for winding up the old contact wire and/or carrying cable being dismantled;
- an *installation unit*, comprising the FUM 100.128 catenary renewal machine and a trackwork vehicle.

For transfer travel of the catenary renewal train, a locomotive is used.

The catenary renewal train can be operated in assembly-line mode for:

- the *exchange of a complete catenary*, i.e. both contact wire and carrying cable, which embraces (Fig. 4):
    - the *dismantling of the old catenary*: standing on the elevating work platform of the trackwork vehicle, which can be controlled from both the control desk of the vehicle and by remote control, two fitters release the fastenings of contact wire and carrying cable, and remove the droppers. Using a height adjustable lifting mast with deflecting rollers, the old contact wire and carrying cable are wound up onto respective storage drums on-board the drum wagon;
    - the *installation of the new catenary*: using its telescopic lifting masts, the FUM 100.128 installs the new carrying cable and contact wire in the required position, with the final operating tension. The pre-selected final operating tension is monitored electronically and kept constant during all travel movements of the vehicle. Standing on the elevating work platform of the trackwork vehicle following behind, two fitters perform the final assembly work, such as the installation of steady arms and droppers.
- The combined carrying cable and contact wire exchange work requires:
- 2 fitters for the dismantling work;
  - 2 fitters for the assembly work;
  - 4 operators for the two trackwork vehicles, the drum wagon and the FUM 100.128;

Installation of new contact wire and carrying cable

Winding up of old contact wire and carrying cable

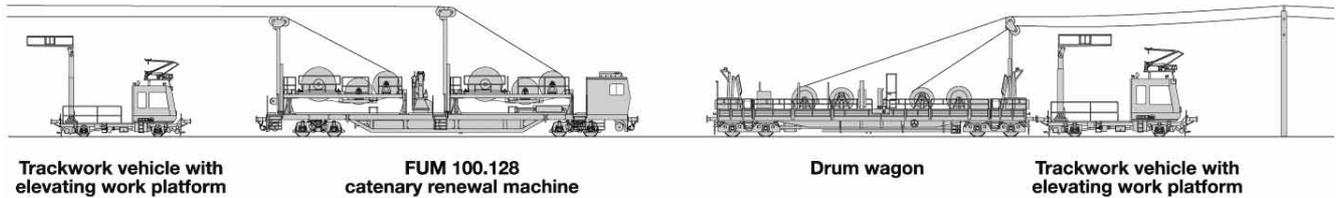


Fig. 4: Exchange of a complete catenary, i.e. both contact wire and carrying cable

Installation of new contact wire

Winding up of old contact wire

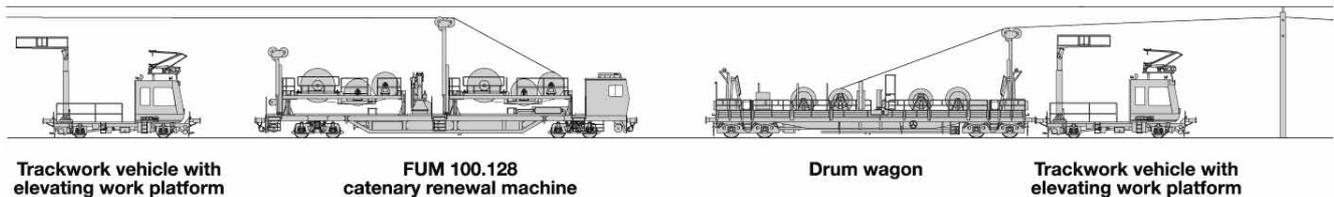


Fig. 5: Exchange of contact wire only

— the exchange of contact wire only (Fig. 5): in principle, the procedure for this type of work is almost the same as that for exchanging a complete catenary, with the difference being that only the contact wire is dismantled and wound up and that, on the FUM 100.128, only one winch unit is used to install the new contact wire. Thus, in the case of exchange of contact wire only, twice the number of contact wire sections can be installed with one loading of the vehicle. The fitters perform the same work as for the exchange of a complete catenary.

#### Range of application

Under normal circumstances, when using the catenary renewal train incorporating the FUM 100.128, it is possible to exchange two catenary sections of contact wire or one catenary section of contact wire and carrying cable before the cable drums need replacing.

This output can be increased by carrying additional drums of contact wire and/or carrying cable on the drum wagon, which can carry up to eight drums with a maximum diameter of 1,900 mm. Thus, in the case of exchange of contact wire only, up to eight catenary sections of contact wire could be installed and, in the case of the exchange of a complete catenary (both contact wire and carrying cable), four catenary sections. In consultation with carrying cable and contact wire manufacturers, further optimisation is being sought, e.g. through special drum windings.

The FUM 100.128 catenary renewal machine enables the installation of contact wire and carrying cable at the final operating tension and in the correct stagger. Installation with the final operating tension, which is possible for all types of catenary (including RE 250 and RE 330), offers three significant advantages:

- the contact wire and carrying cable can immediately be clamped in the brackets or steady arms, and the droppers installed in the same operation;
- re-adjustment of the brackets and steady arms is no longer needed, as the wires and cables do not require re-tensioning;
- the compensator weights for tightening the wires can immediately be set at the required height, i.e. they require no further adjustment.

Thus, as compared to using conventional methods, track possessions are greatly reduced.

#### Further advantages of the FUM 100.128

A further technical advantage is offered by the fact that the FUM 100.128 catenary renewal machine features tilting winch units which, with their laterally displaceable storage drum holders, friction winch reels and telescopic lifting masts, guarantee straight and twist-free guidance of contact wire and carrying cable as they are installed and their required lateral position (stagger).

During work operation, the FUM 100.128 can travel at a speed of between 0 and 7 km/h. Its maximum self-propelled speed is 40 km/h. When placed in train formation for transfer travel, a speed of up to 120 km/h is possible.

The FUM 100.128 can haul a load of up to 40 t and, during work operation, negotiate gradients of up to 40‰.

#### Output

Using the catenary renewal train incorporating the FUM 100.128, it takes three hours to exchange a section of complete catenary. As compared to conventional methods, this results in shorter track possessions and, thus, a higher line availability, and cost savings of up to 50%.

Also, due to careful handling of the material, there is an increase in the quality of work performed and, also, a safer working environment for the fitters. Adjacent tracks do not require closure during work.

#### Considerations for planning operations with the catenary renewal train incorporating the FUM 100.128

The efficiency and effectiveness of operating the catenary renewal train incorporating the FUM 100.128 for catenary maintenance and renewal programmes depends, apart from the effects resulting from its range of application, to a large extent on the planning of appropriate measures and operations with the catenary renewal train.

The full advantages of the catenary renewal train incorporating the FUM 100.128 can only be achieved by compiling a well-tuned catenary exchange programme. DB Bahnbau GmbH offers customers advice and assistance in this respect.

Ideal operating conditions for the catenary renewal train are to be found in continuous worksites, thus resulting in a reduction of track possessions and costs for the network operator.

The greater the number of consecutively assembled catenary sections is, the more effective is the application of the technology. The relatively high initial capital outlay, as compared to that for conventional technology, quickly pays itself back.

In the process of operation planning with respect to the catenary renewal train, the Catenary Division of DB Bahnbaue GmbH also takes care of the following tasks:

- provision of overhead line materials and, if required, disposal of old material;
- organisation of the operational logistics to transport the catenary renewal train to and from the worksite, using a locomotive owned by DB Bahnbaue GmbH;
- local training of all persons involved, following instruction of the operating staff of DB Bahnbaue GmbH by those responsible at DB Netz AG for catenary installations;
- adoption of service tasks during the preparation and performance of the work (concerning electrical current and earthing).

Preparing the catenary renewal train incorporating the FUM 100.128 for deployment, organising the transfer of the machines

to/from the worksites, and providing technical attendance to the machines, including the organisation of repairs, is performed by the mechanical engineering depot of DB Bahnbaue GmbH in Leipzig, Germany.

#### **Conclusions**

With the FUM 100.128 catenary renewal machine, the Catenary Division of DB Bahnbaue GmbH has set new standards with respect to the mechanisation of catenary installation. Its application enables a fast, accurate and, therefore, cost-effective installation of overhead lines. Thanks to the optimised sequence of assembly and the fact that contact wire and carrying cable are installed immediately with the final operating tension and in the correct stagger, re-adjustments are no longer required, thus greatly reducing track possessions.

The joint planning of machine deployment between customer and contractor leads to an efficient and cost-effective use of the catenary renewal train incorporating the FUM 100.128. This, together with the range of application of the catenary renewal train incorporating the FUM 100.128 machine ultimately leads to considerable savings in working time and costs.

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