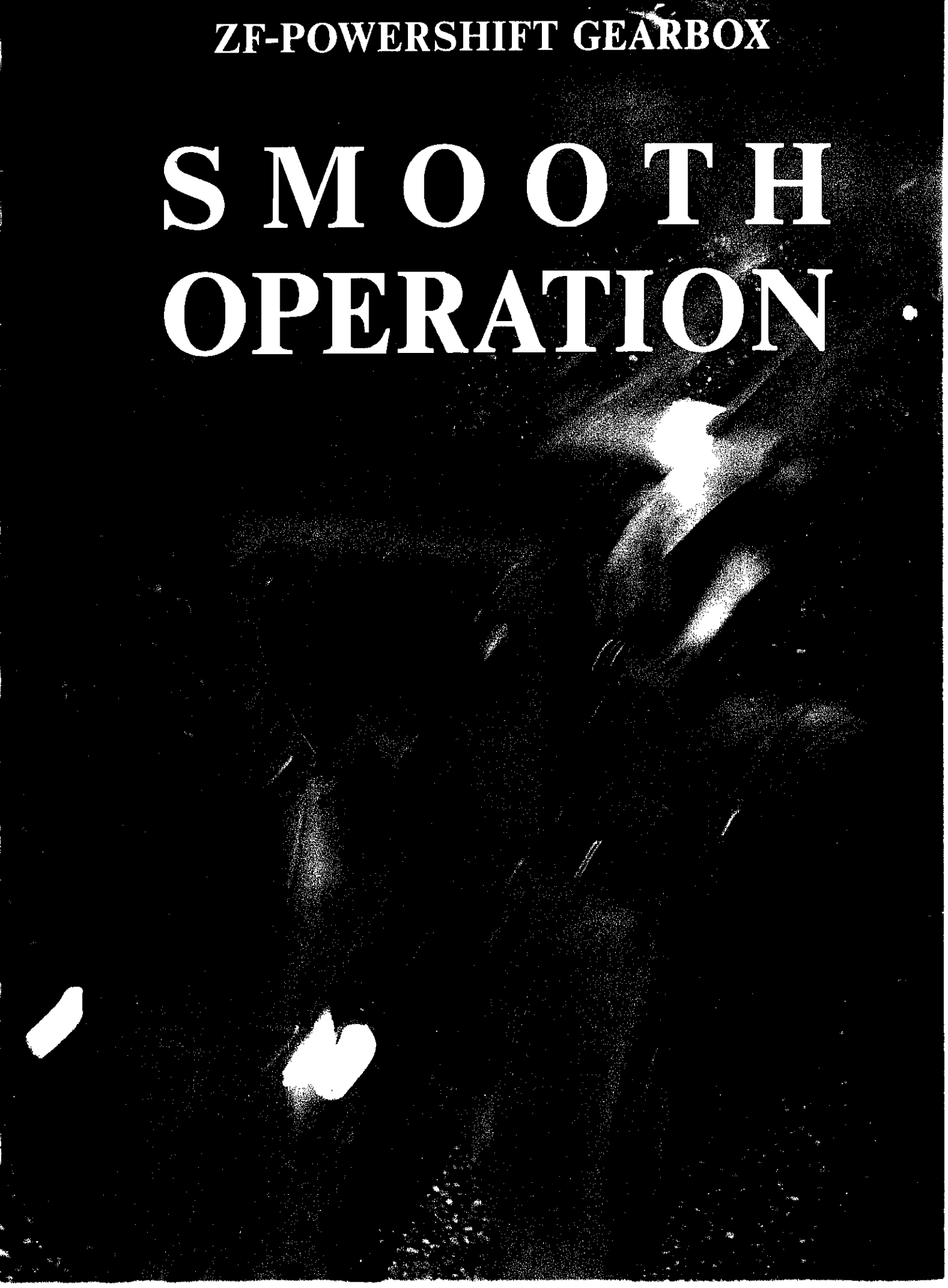
ZF-POWERSHIFT GEARBOX

SMOOTH OPERATION



ZF HAVE BEEN designing and building powershift gearboxes at their factories in West Germany since the fifties and they certainly rate among the most experienced manufacturers in the world.

As a result of the close co-operation forged between ZF and vehicle manufacturers, a new generation of powershift gearboxes has been developed to suit a wide range of vehicle applications. Although of the same family, the new generation can be adapted to take account of a variety of applications to provide optimum performance in any situation.

Economy is a prime consideration

ZF powershift gearboxes convert engine output into maximum work efficiency. They enable engines to operate within the most effective torque range, or at output torques giving maximum economy.

Any machine is only as good as its controlling or regulating system

The electro-hydraulic systems available for ZF powershift gearboxes (offering various levels of automatic operation) can hardly be improved upon. The driver can devote his full attention to the road or terrain conditions.

On site service

An added economy feature of ZF powershift gearboxes is that oil filters, electronic modules (even the complete oil pump on the WG 250) are accessible from the outside of the unit and are removable without having to dismantle any other components.

A ZF gearbox usually outlives the vehicle

ZF powershift gearboxes are known for their long life.

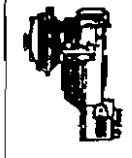
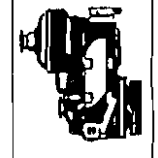
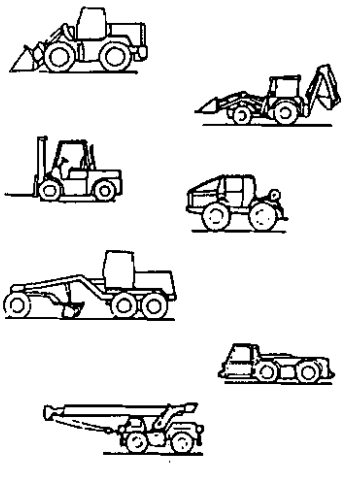
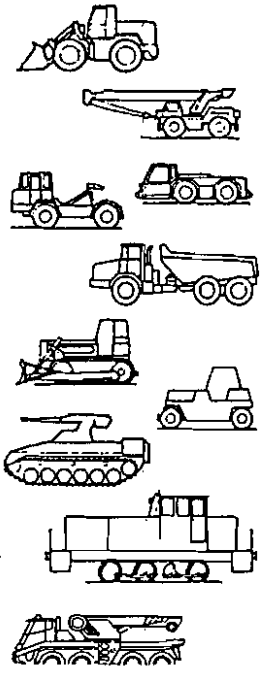
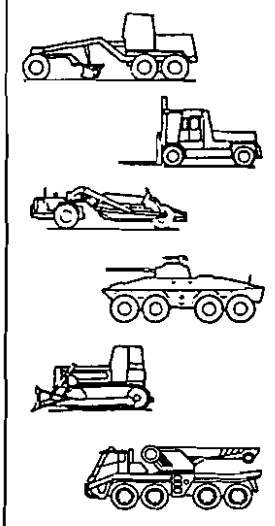
Firstly, their torque capacity provides a wide operating margin. Secondly, ZF's no-compromise quality control of materials and manufacturing precludes premature wear of all vital components. There is also the tested and unrivalled operating efficiency at low and high temperatures. The likelihood of a serious failure in gearboxes which are correctly matched to the vehicle is extremely remote.

The most comprehensive range of auxiliary components for any application

Any ZF powershift gearbox can be equipped with the suitable components such as power take offs or auxiliary drives to adapt it for special applications – all from a single source and all to the same high standards of quality.

Worldwide ZF service

ZF service through highly trained staff and an efficient spare parts supply system is always within easy reach wherever you might be operating your machines – a reassuring fact even if their assistance is very rarely required.

Type	WG 80/85 (Transaxle)	WG 100 101	WG 120 121	WG 150 151	WG 180 181	WG 200 201	WG 250 251	WG 65
Max. engine output (kW)	38/50	70	105	135	170	190	220	260
Max. turbine torque (Nm)	340/440	650	800	1000	1350	1500	2000	2450
Forward Gears	1	2/3/4/ 5/6	3/4/5/6	3/4/5/6	3/4/5/ 6/12	3/4/5/ 6/12	3/4/5/ 6/12	4/8
Reverse Gears	1	2/3	3	3	3/6	3/6	3/6	4
Long drop								
Short drop								
Popular applications								

THE FOLLOWING two powershift transmissions have been specially developed for the lifttruck market. Their extremely compact design enables the vehicle manufacturer to build highly manoeuverable lifttrucks with a low center of gravity and optimal mast locations.

WG 80 – No. 1 in its class worldwide

Matched with the flange-mounted axle, the WG 80 is a compact, finely tuned drivetrain which quickly has become the most successful drive system for lifttrucks of capacity up to approximately 4 t.

Of significance is the no-wear torque converter, which allows for quick operation. Additionally, a separate inching valve provides highly accurate manoeuvring. The engine dependent pump drive is integrated into the transmission. It operates without powerloss and requires no extra mounting space.

Self-adjusting brakes and an integral cooling system provide easy mainten-

WG 85 – new performance features for lifttrucks

The WG 85 is not only one performance class higher, it offers substantial differences from common transmissions. This could be considered a *new generation* of lifttruck transmission.

Part of the innovation are the helical cut gears. Together with the optimized gear tooth design there is a considerable reduction in noise level. Naturally, the WG 85 is available with options important for lifttruck performance and handling. Examples are inching valve, electric shift and hydraulic pump drive. The transmission can be flange-mounted directly to our lifttruck axle for a compact package.

WG 100 - new dimensions for the 100 hp class

TO ROUND OUT our transmission series, we developed the WG 100. Now there is a transmission for the 95 hp class vehicles, offering all of the performance features of the ZF-powershift transmissions.

Broad range

Especially in this performance class, the diversity of working machines is constantly growing. The varied specializations require a constantly increasing range of flexibility also from the transmission technology. That is why we offer the WG 100 with 2, 3, 4, 5 or 6 forward and 2 or 3 reverse speeds. The closer the gear ratios are, the better the transmission utilizes the power and torque provided by the engine.

For all possible applications

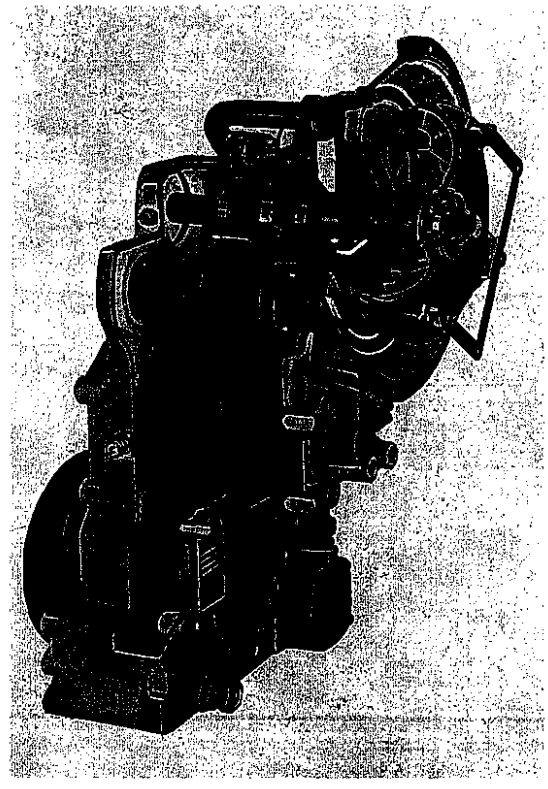
The WG 100 is available in long and short drop versions. The available transmission ratios, combined to ZF axles, offer unlimited fit-up and installation possibilities. The integrated pump drive allows full output utilization.

Low noise level

Helical gearing and high surface quality of the gear tooth are the reasons for the extremely quiet performance of the WG 100. Additionally, the housing design has been optimized for minimal noise in the transmission.

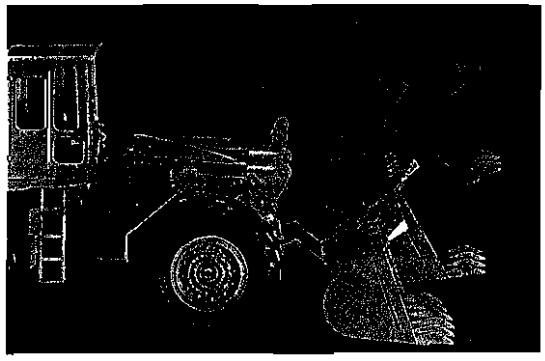
Manual and fully automatic shift controls

The WG 100 utilizes an electro-hydraulic shift selector which is operated by our proven single lever shift selector. ZF offers various options from the simple manual to a fully automatic gear selection. In particular, the electronic, or automatic control unit can substantially raise the efficiency of the application because of programmed handling during the load cycle. There are also design advantages resulting from the ease of installation and matching to the vehicle.



***MOST FRONT LOADERS** fall within the 100 kW class so why should advanced transmission engineering be reserved for large machinery only?*

Within their range, ZF powershift gearboxes, WG 120/121 and WG 150/151, offer everything that today's engineering can give us to make the operation of vehicles and machinery more economical, more effective and safer.



Close ratios forward and reverse

3, 4, 5 or 6 forward gears are available depending on the application and the maximum speed required. 3 reverse gears are always available and this is particularly important for economy and engine life considering the fact that a front loader runs in reverse for approx. 40% of its operating life.

Finger-light control

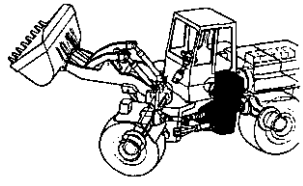
The advantages of close gear ratios will only be significant when gears are changed at the right moment. Gear changing must be accomplished positively and with as little physical effort as possible, particularly on a machine on which implements must also be operated. Easy-to-grip control levers of various designs are available for different applications. They operate electronically and are easy to move.

Steering column mounted, panel mounted and rotary reversing controllers are available alternatives.

Electronics make a fully automatic system possible

All WG gearboxes (except WG 80) are also available with a fully electronic control system. The automatic system simplifies the operator's work, reduces his physical effort and is ideal for industrial machinery since it always reacts at the optimum moment.

ZF specialists will be pleased to advise you on the best control system.



A perfect match from modular design

The description of the WG 180/200 (see the following pages) also contains full details of the comprehensive range of ZF auxiliary components which can modify the WG 120/150 gearbox to meet the needs of any special vehicle or machinery.

PTOs transmit full engine power

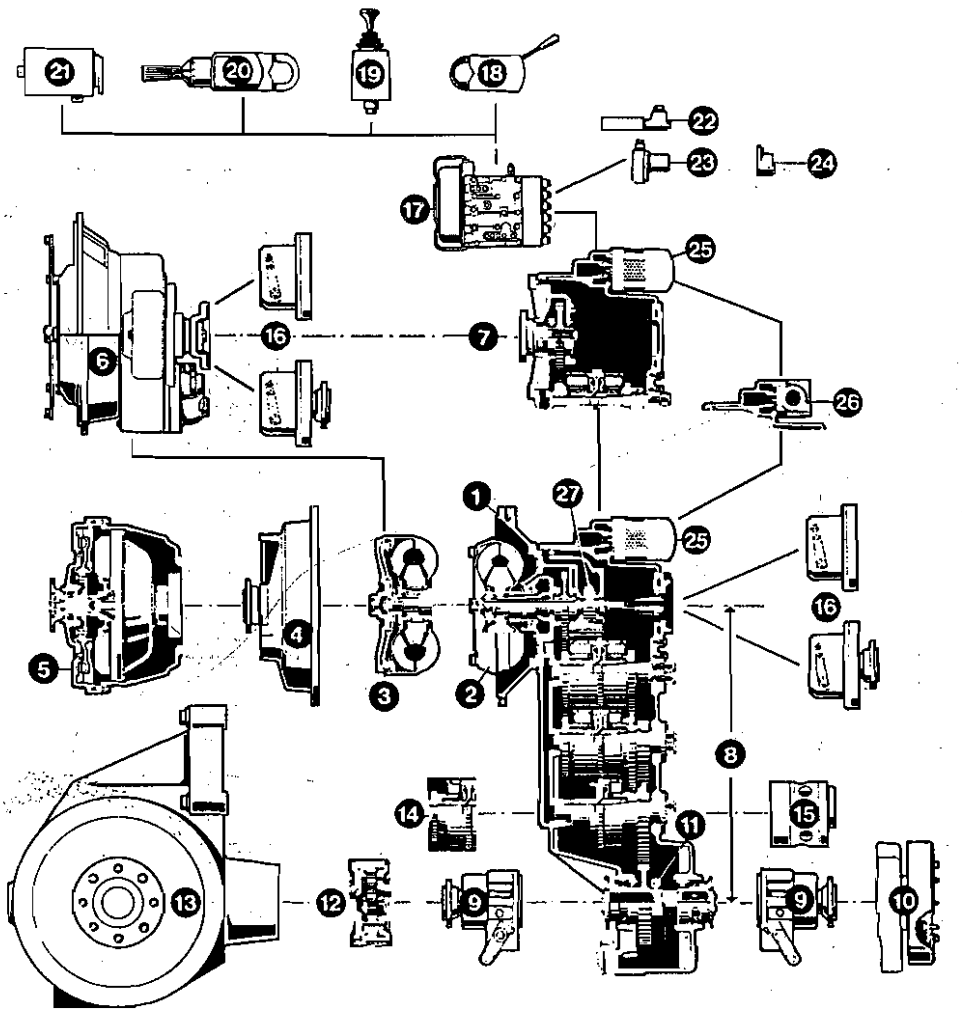
Any ZF powershift gearbox has at least one PTO at its output end, capable of transmitting full engine power.
An additional PTO is available for the WG 120/150/180/200 as optional extra.

A LARGE VARIETY of vehicles in the 100 to 200 kW output class also need efficient transmissions. Front loaders, cranes, dumpers, airfield tractors, RO/RO tractors, shunting locomotives and compactors, to name but a few, are the best examples of vehicles for which the WG 180 and WG 200 gearboxes are ideal.

Two gearbox models for all these different requirements?

Whether it is a wide speed range as in the case of an AT crane or dumper... or whether converting engine power into tractive force is the prime consideration as in the case of the bulldozer... or if 100% of the hydraulic power must be available at certain times as on a front loader... the ZF gearbox can always be adapted or modified to suit any special applications.

Optimum matching to any specific application thanks to a unique and versatile auxiliary component range.



1 Converter housing for direct installation
2 Torque converter
3 Lock-up clutch
4 Housing for separate installation
5 Retarder
6 Torque converter unit - HN 500
7 Drive flange (for separate mounting)
8 Drop distance between input and output shafts
9 Axle disengagement unit
10 Parking brake
11 Speedometer connection
12 Inter-axle differential
13 Flange mounted axle drive
14 Multi-plate clutch for 4, 5 and 6 speed versions
15 Emergency steering pump
16 PTO, engine dependent
17 Gearbox control
18 Steering column controller SG 4/SG 6
19 Console mounted controller SG 4/SG 6
20 Rotary hand controller DW 1
21 Automatic gear controller EST 2
22 Inching valve
23 Double step modulation valve
24 Pressure cut-out
25 Fine filter
26 Gearbox connection for separately mounted oil filter
27 Converter charging pump

OPERATING A ZF powershift gearbox, for example on a 70 ton container lift truck powered by a 250 kW engine, is child's play. The gear lever can be moved to the required gear position with just one finger.

The ZF "softshift"system operates automatically, provides rapid action on the one hand, and on the other hand, ensures that clutches are fully controlled by the hydraulic system, closing and opening smoothly. Such smooth action benefits both man and machine.

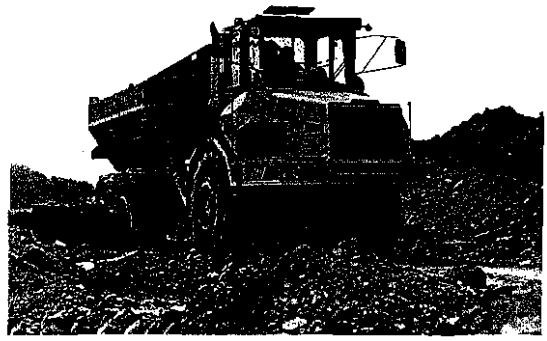
Added protection from excessive stresses and wear is provided by the automatic system. With it, gear changing always occurs at the optimum moment. It is not possible to over rev or stall the engine. This type of optimum safety from an automatic system is particularly valuable on crane vehicles which run under load. Should the power supply to the automatic system fail, a safety feature shifts the gearbox automatically into neutral (N) so that the operator cannot be caught out.

Safety for man and machine

Additional safety is provided by the broad program of ZF's auxiliary components, such as:

The *retarder,* a highly effective no-wear hydraulic brake for continuous operation under severe conditions.

The *emergency steering pump* which maintains manoeuverability when the engine cuts out even on the very heaviest machines.



The *lock-up clutch* which not only increases economy and tractive force but also allows engine braking.

Consequential economy

Economy, apart from safety, is the most important positive aspect to decide in favour of the ZF gearbox.

Low unit weight. The layshaft design together with its computer-optimized components saves a great deal of weight in comparison with other solutions whilst offering better output and service life.

Close gear ratios, lock-up clutches and electronic control ensure the best possible output utilisation.

Purpose designed auxiliary components available with new gearboxes, eliminate the necessity for compromise solutions or expensive conversions at a later stage.

The easy-to-service design (WG 250 should serve as a special example in this instance) drastically reduces vehicle downtime. Oil filters are accessible from the outside. Almost all service work can be carried out quickly and safely at the work site. While the worldwide ZF service network is your guarantee for efficient spare parts supply.

THE EFFICIENCY of every construction vehicle also depends on how well the driver is able to work with it. This becomes clear to anyone who has observed, for example, the working cycle of a wheel loader.

To implement the advantages of the ZF powershift transmissions most favorably into practice for each application, we have developed a system of transmission controls. The basis is always an electrohydraulic selector control valve, which, in connection with the converter, is responsible for a soft gear shift change without tractive force interruption. It is controlled by a gear selector mounted to the steering column or console.

Sturdy gear selectors

Single lever gear shift selectors are equipped with or without active lock, as desired and according to the application. Depending on the type of transmission, the range selector can have up to 8 forward and 4 reverse speeds which can be selected directly through the electrohydraulic transmission control system. For gear selectors with active down shift lock, there is an integral time- or speed dependent control system which prevents the engine from overspeed. On transmissions with converters with lock-up clutch, this clutch is shifted automatically through an electronic control.

Rotary controller for wheel loaders

The rotary controller was developed by ZF especially for easier manoeuvering of wheel loaders. Horizontal movement of the lever changes the vehicle direction, whereas rotation of the handle changes the gear speed. On the basic model, a combination of four forward and reverse speeds can be selected in this manner.

The advantages are increased freedom of arrangement and lower cost for design and installation, due to elimination of the gearshift linkage. With the electronic version, the rotary controller is used only as a setting device. The control of the transmission shifting is taken over by the integral, preprogrammed microprocessor. The advantages of the electronic control system are customer optimized tuning of the transmission to each application, high safety against operating errors and additional functional comfort.

To increase tractive force during the loading operation, downshift by one gear is possible with the integrated kick-down switch. Especially on wheel loaders reversing is possible in all gears, and shifting from the second to the first gear can always be made through the integrated kick-down switch, and at corresponding driving speed, the electronic control then automatically shifts up to second gear.

Automation of the gearshift selection

Change from manual to automatic operation can be made by simply exchanging the electronic control unit. The microprocessor is programmable. Up- and down-shift points are electronically controlled and tuned to the vehicle and individual application. The shift points correspond instantly to your current operation status, as determined by throttle, position kick-down, as well as engine-brake and retarder load. Furthermore, a change between the two operating ranges is possible. As a safety feature, ZF also offers a neutral safety lock while the vehicle is at rest.

COUNT ZEPPELIN established the ZF company with the aim of producing better gears for his airships some 70 years ago.

No-compromise quality was the firm foundation for ZF's successes then and remain so now.

This applies equally to all the ZF factories where rugged and long life gearboxes and axles for industrial and agricultural machinery are built.

ZF quality goes beyond meticulous design and manufacture. We even supervise correct installation of our units in our customers' factories. Our approval procedures for first unit installation might appear to some as unnecessarily strict but they achieve the best results for vehicle operators throughout the world.