



all wheel control system

4 wheel drive + anti spin + anti lock



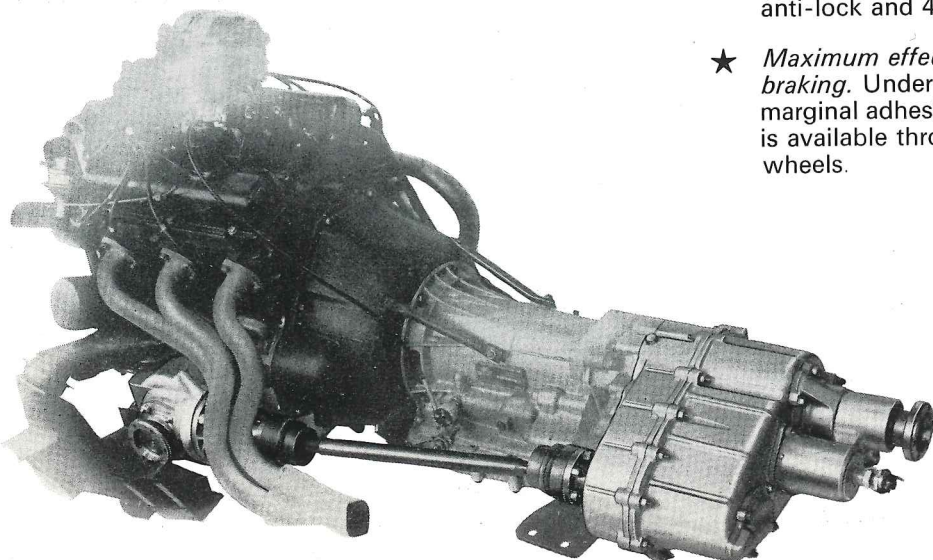
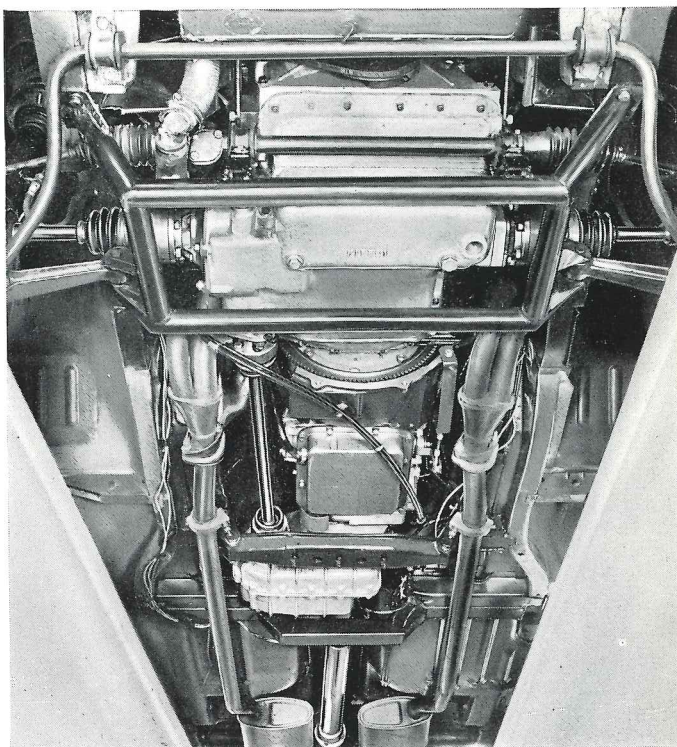


A significant advance in vehicle stability

The GKN FF system has aroused much interest in the motoring press for its greatly improved vehicle controllability. Many leading correspondents representing motoring journals published in the United Kingdom and Europe recently test drove cars fitted with the GKN FF system. They enthused on the improved steering, road holding and braking and subsequent editorial reports stated that the system "gave a feeling of safety never experienced in any other car" and "could be a life saver".

Unique features of GKN FF system

- ★ *Wheel spin during acceleration is virtually eliminated.* Faster get-away which leaves other conventionally-powered cars standing. Enables standing starts in conditions of mud, snow or ice to be effortless and worry free.
- ★ *Wheel lock during braking is virtually banished* — all wheels slow down at the same rate. Automatically controls servo-brake pressure permitting higher pedal pressures and shorter stopping distances.
- ★ *A revolutionary concept of motoring, providing superb road handling, increased driver relaxation and maximum control under difficult road conditions.*
- ★ *Safer emergency braking* — up to 20% reduction in braking distance in wet or icy conditions.
- ★ *Ten year testing.* The system has been rigorously tested on a wide range of vehicles over this period.
- ★ *4 wheel drive safety.* The only system currently being produced which provides all three essential safety features, anti-spin, anti-lock and 4 wheel drive.
- ★ *Maximum effective engine braking.* Under conditions of marginal adhesion, engine braking is available through all four wheels.



Above: Master differential and Maxaret unit fitted to a passenger car.

Left: Typical engine and gearbox with Master differential attached.

GKN FF system

"16 OCTOBER 1969. GKN BACKS FERGUSON FOUR WHEEL DRIVE AND ANTI-SKID WORLD WIDE

World manufacturing and marketing rights of the Ferguson Formula 'all wheel control' system, developed extensively during the past ten years by Harry Ferguson Research Limited of Coventry, have been acquired by the Transmissions Division of the vast GKN Engineering Complex". The above quotation from GKN's Press Release announced the growing success of a concept which began in the nineteen thirties.

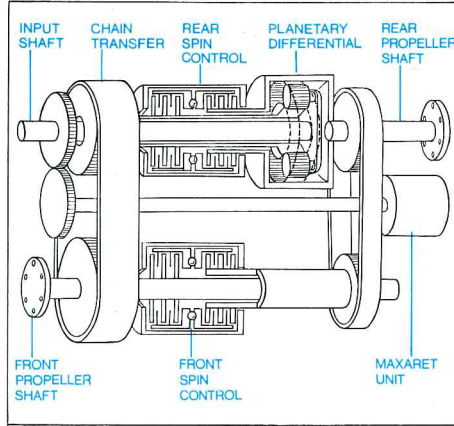
In 1950 Harry Ferguson Research Limited was formed to develop the Dixon-Rolt 4 wheel drive concept. Harry Ferguson was convinced of the future of 4 wheel drive. In 1954, having sold his tractor interests, a vast FF research programme was undertaken. During this period near finalised versions of alternative passenger cars were demonstrated to the Motor Industry.

In 1960 Harry Ferguson suggested that they build a racing car embodying 4 wheel drive and other ideas. Twelve months from the initial drawings by Claude Hill and his team, the Ferguson P.99 car driven by Stirling Moss won the Gold Cup Race at Oulton Park.

In October 1965 the Jensen FF was announced and set new standards of road behaviour for production cars.

Now the Ferguson 4 wheel drive system has become the GKN FF, to be manufactured by GKN Birfield Transmissions Limited, who are specialists in the economic production of components for safer motoring; the FF is a major contribution in achieving this aim.

rear output shaft and the sun wheel to a sleeve carrying a sprocket which drives the front output shaft via a special type of chain.



Master differential layout.

Torque Split

Torque from the input shaft is split unequally between front and rear by means of the difference in diameter of the annulus and sun gears. That it is advantageous to deliver more than half the torque to one pair of wheels was one of many 'breakthroughs' in the development of the FF system.

Control Clutches

Limitation of differential action is achieved by the unique Ferguson principle of connecting the sun wheel and front output shaft by a chain drive having a ratio such that the rear spin control clutch is over-running by about 5%. This clutch is interposed between the sun wheel and the rear output shaft, and permits the rear wheels to revolve up to 5% faster than the fronts, but no more (limiting rear wheel spin), and the fronts to slow no more than that amount below the speed of the rear wheels (controlling front wheel locking). The front spin control clutch is mounted on the front output shaft and is also chain driven, with a ratio which allows over-running by about 20%. This clutch controls front wheel spin and

rear wheel lock, and provides sufficient master differential freedom to allow full steering lock without tyre scrub.

When either output shaft speeds up through wheelspin to the point when it causes its control clutch to lock, it is held at the 'plus speed' by the difference in chain drive ratio. This percentage speed increase can be maintained indefinitely, and in this the Ferguson system differs completely from limited-slip differentials which depend upon differential action being restricted by internal friction.

Dunlop 'Maxaret'

Accidental wheel locking is made virtually impossible by this unit, which intervenes when excessive brake pedal pressure is applied. The sensing unit, which is driven by the input shaft, incorporates a free-running flywheel. As the wheels approach locking point, the sensing shaft decelerates and causes the flywheel to over-run. The over-run in flywheel rotational speed is translated into axial movement by means of a cam which, through an electrical solenoid, actuates a control valve. This momentarily reverses the action of the vacuum brake servo, thus releasing the brakes until the wheels accelerate and then re-applies them until locking point is again approached. The entire cycle is repeated several times per second, the resultant 'pumping' action keeping the wheels precisely on the verge of locking at which point they exert maximum retardation. When braking violently on very slippery surfaces, if the pulsation of the pedal is ignored, and further heavy pressure is applied, the wheels may ultimately lock. The driver, can, however, apply much more pressure to the pedal before locking occurs than with a conventional car, and therefore has a greatly increased margin of safety. In addition, the pulsation of the pedal provides a valuable 'early warning' of treacherous conditions.

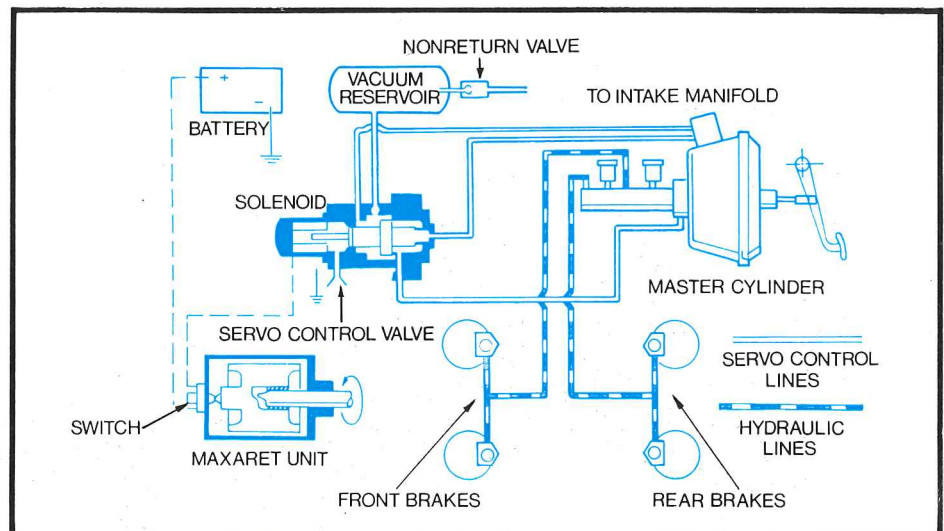
Below: Maxaret braking system.

How GKN FF works

Master Differential

The basis of the system is the 'controlled freedom' centre differential that allows speed differences between the front and rear wheels within limits controlled by two self-locking clutch packs, and which also divides the torque unequally between front and rear wheels.

This master differential comprises an epicyclic gear train in which the input shaft is connected to the planet carrier, the annulus to the



Specification

Weight: Master differential 70 lbs. (32 kgs) approx.
Additional: propeller shafts, drive shafts,
differential 80 lbs. (36 kgs) approx.
Maxaret unit — 5 lbs. (2.3 kgs) approx.†

Length of Master Differential: 12 in. (30 cms)
approx.

Brakes: As for conventional vehicle with servo
system.

Tyres: As for conventional vehicle.

Steering: As for conventional vehicle with modified
steering linkage as required.

Transmission Torque Split: Normally 37% front
and 63% rear.

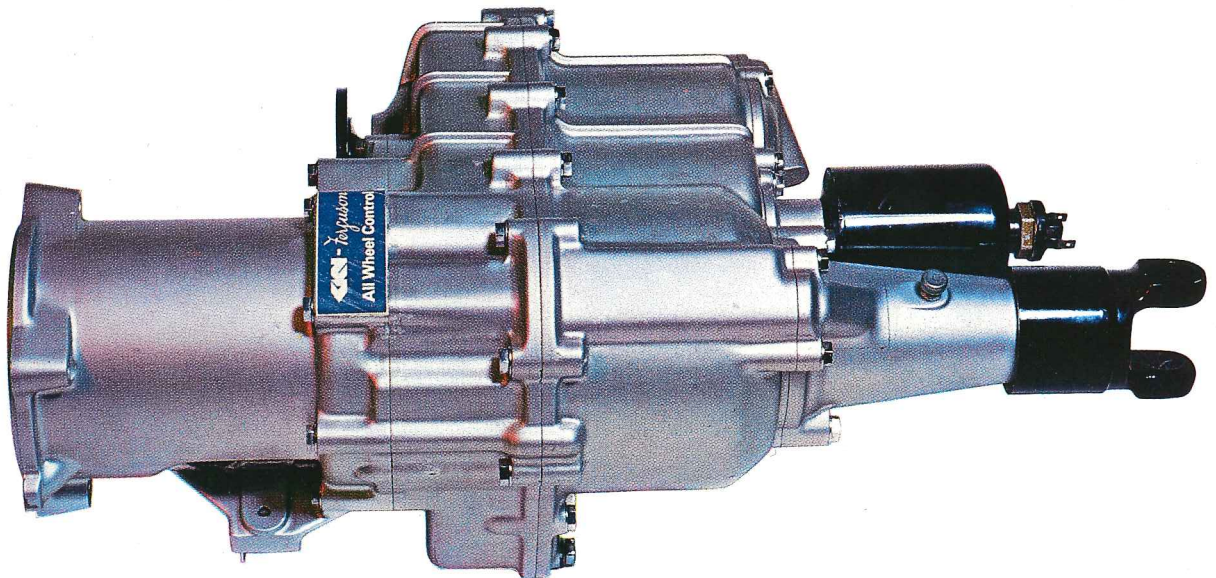
Over-run Allowance: 15-20% front, 2-5% rear.

Suspension: As for conventional vehicle.

Propeller Shaft Joints: All additional joints are of
GKN and Birfield Constant Velocity type.

*Patents: The Ferguson Formula is fully protected by
patents both in U.K. and overseas.*

“FERGUSON FORMULA, F.F. and the F.F. symbol
are the trade marks of Harry Ferguson Research
Limited for their All Wheel Control Transmission
System now manufactured and sold under Licence by
GKN Transmissions”.



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