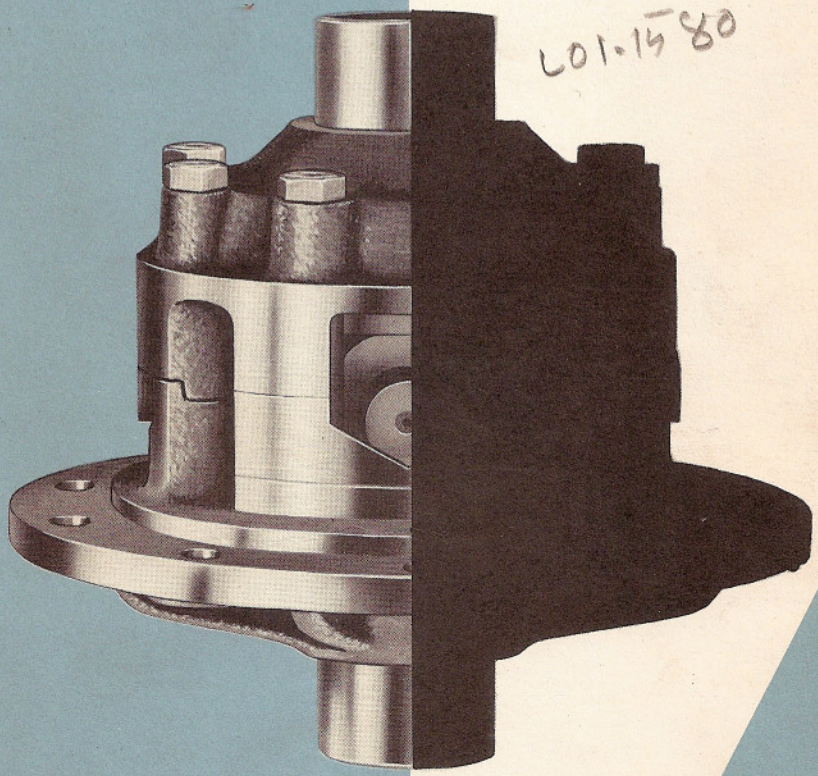
THE Spicer THORNTON

POWR-LOK

DIFFERENTIAL

L01-1580



For . . .

Passenger Cars
Station Wagons
Light Trucks

DANA

DANA CORPORATION • TOLEDO 1, OHIO

Bulletin No. 360A

LITHO. IN U.S.A.

What is a Locking Differential?

A locking differential is a device which permits an automotive axle to transmit the major driving force to the wheel with the *better* traction.

What are the functions of a Locking Differential?

1. An efficient locking differential will prevent a vehicle from becoming immobile when one driving wheel loses traction.
2. An efficient locking differential provides vehicle safety and stability during high speed driving. It prevents wheel spinning and sudden shock loads due to wheel bounce over rough roads or non-uniform surface conditions such as ice and snow spots, wet and dry pavements, sand and gravel, and one wheel getting off the pavement.

What are the requirements of a good Locking Differential?

As specified by Dana, these requirements include:

1. It must maintain differential action.
2. It must prevent shock loads and the transfer of full engine torque to one axle shaft—so must *not* be of the *full* locking type.
3. It must provide sufficient traction torque to the non-spinning wheel at all times and under all operating conditions.
4. It must not interfere with steering.
5. It must provide increased safety, improved stability and handling by preventing wheel spinning under varying traction conditions.
6. It must be of long life and not subject to abnormal loads or wear.
7. It must continue to function efficiently regardless of the amount of wear.
8. It must be quiet in operation.
9. It must be of minimum cost, size and weight.
10. It must be interchangeable as a unit with present Spicer differentials.

Spicer

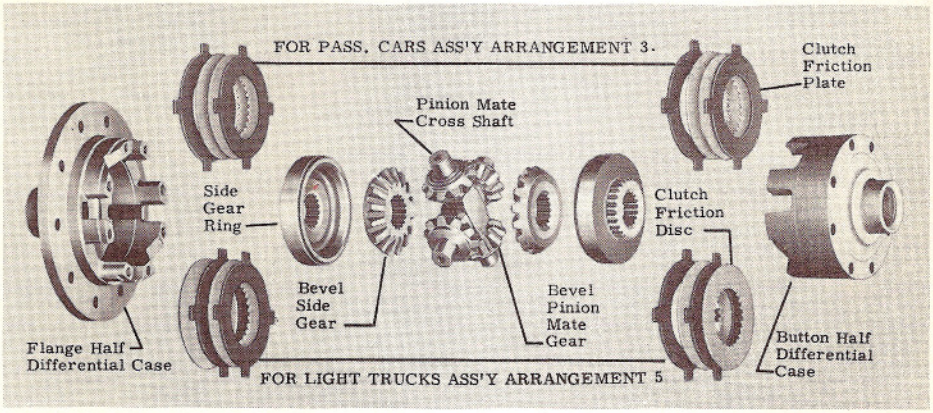
The Spicer Thornton POWR-LOK Differential

Date: January, 1958

POWR-LOK CATALOG X580

Supersedes X580 Dated June, 1957

APPLICATIONS FOR PASSENGER CARS & LIGHT TRUCKS AND POWR-LOK COMPONENT PARTS



INDEX

LIST OF OLD AND NEW (Superseding) PART NUMBERS

Old Part Number	New Part Number	Old Part Number	New Part Number
20663X	21035-3X	20726X	21036-3X
"	21035-5X	"	21036-5X
20666X	21037-3X	20729X	21038-3X
"	21037-5X	"	21038-5X

Old Part Number	New Part Number
30476 n. s. s.	Use Side Gear Kit
30499 n. s. s.	Use 21346X
30729	30937
30730	30938
30746 n. s. s.	Use 21345X

POWR-LOK CHANGE-OVER NOTES

Chevrolet: In some early 1957 Models there is a rib in the Axle Carrier Housing which interferes with the Powr-Lok Differential installation. Remove this rib by grinding or milling before attempting to install the Powr-Lok Differential.

The following Powr-Lok Kits are for use with Axles made by Chevrolet. In the applications:

Spicer 21003X Replaces Chevrolet 3737717 Differential Case
" 21005X " " 3731614 " "

Chevrolet or Ford: It may be necessary on some Models to grind 1/16" from spline end of the axle shaft. Shafts must have clearance with pinion mate cross shafts in Differential Case.

Chrysler, Dodge, DeSoto, and Plymouth: It will also be necessary to replace the Differential Bearing Cones (See Applications). It will also be necessary to grind 3/32" from the spline end of each axle shaft.

Willys: On Models with straight sided spline axle shaft, (see applications) it will be necessary to replace these axle shafts.

Supersedes Catalog X580 Dated June, 1957.

PRINTED IN U.S.A.

Thornton POWR-LOK Differential

RATIO AND TOOTH COMBINATION TABLE

FOR POWR-LOK DIFFERENTIAL REPLACEMENT KITS IN PASSENGER CAR AND LIGHT TRUCK AXLES

NOTE: To determine the AXLE RATIO: Obtain the Tooth Combination from the RATIO TAG which is attached to the Axle Cover. Example: Tooth Combination (Ratio)—46-13 Ring Gear has 46 teeth and Pinion has 13 teeth.

SPICER AXLES	FAST RATIOS						SLOW RATIOS					
AXLE RATIO	2.87	3.07	3.15	3.31	3.54	3.73	3.92	4.09	4.27	4.55	4.89	5.38
TOOTH COMBINATIONS	43-15	43-14	41-13	43-13	46-13	41-11	47-12	45-11	47-11	50-11	44-9	43-8

POWR-LOK KITS—GROUP LISTING

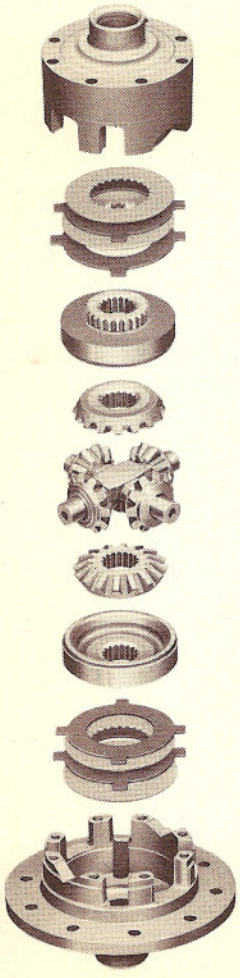
FAST RATIOS 3.91 & BELOW		SLOW RATIOS 3.92 & ABOVE				USED BY ③
Passenger Car	Truck	Passenger Car	Truck	KIT TYPE	FOR AXLE MODEL	Make & Year
20641X	.....	20674X	.....	Cone	Spicer 53	Continental 56-58, Lincoln 51-58, Packard 1956
20644X	20644X	20684X	20684X	Cone	Spicer 45, 47	GMC 56-57, Mercury 55-56, Packard 1956
.....	.....	.....	20785X	Cone	Spicer 53	Willys 53-58
21003X	.....	.....	.....	Disc	Chevrolet	Chevrolet 55-58
21005X	.....	.....	.....	Disc	Chevrolet	Chevrolet 55-58, Corvette 56-58
21035-3X	21035-5X	21037-3X	21037-5X	Disc	Spicer 44-1, 44-3F, 44	Dodge 1957, Ford 51-56, Willys 57
21036-3X	21036-5X	21038-3X	21038-5X	Disc	Spicer 44, 44-1, 44-T	American Motors 52-56, International 54-57, Packard 57-58, Studebaker 51-58, Willys 51-58
21166X	.....	.....	.....	Disc	Chrysler	Chrysler 57-58, DeSoto 57-58, Dodge 57-58, Plymouth 57-58
21239X	.....	.....	.....	Disc	Amer. Motors	American Motors 57-58
21246X (3.23 & Below)	.....	21244X (3.42 & Above)	.....	Disc	Olds., Pontiac	Olds 57-58, Pontiac 57-58
.....	21291X	.....	21293X	Disc	Spicer 45	GMC 1958
.....	21316X	.....	21318X	Disc	Spicer 44, 44-1	International 1958, Willys 1958
.....	.....	.....	21317X	Disc	Spicer 44, 44-3F	Dodge 1958, Willys 1958

COMPONENT PARTS OF SPICER-THORNTON POWR-LOK DIFFERENTIAL ASSEMBLY KITS

Powr-Lok Differential Kit	O.D. & No. of Side Gear Splines	Diff. Case Sub. Assy.	Diff. Case Screw ④	Clutch Friction Disc ④	Clutch Friction Plate ④	Side Gear Ring ②	Side Gear & Pinion Mate Kit ①	Pinion Mate Cross Shaft ②	Axle Shaft Spacer ②	Axle Shaft Roll Pin ①	Ring Gear Screw ⑩
Powr-Lok Kits Used With American Motors Corp Axles											
※21239X	.....	N.S.S.	30762-1	30937	30938	30924	21446X⑳	30908	30482	500595-17	.....
Powr-Lok Kits Used With Chrysler Corp. Axles											
※21166X	.....	N.S.S.	30762-1	30937	30938 30938-3②	30851	21445X⑳	30908	30482	500595-17	.....
Powr-Lok Kits Used With General Motors Corp. Axles											
21003X	1.197"-17 Inv.	N.S.S.	30473⑧	30937	30938	30748	21345X⑳	30481	.....	.....	.....
21005X	1.197"-17 Inv.	N.S.S.	30473⑧	30937	30938	30748	21345X⑳	30481	.....	.....	.....
※21244X	1.285"-29 Inv.	N.S.S.	30762	30937	30938⑥	30943	21447X⑳	30931	.....	.....	.....
※21246X	1.285"-29 Inv.	N.S.S.	30762	30937	30938⑥	30943	21447X⑳	30931	.....	.....	.....
Powr-Lok Kits Used With Spicer Axles											
21035-3X	1.271"-19 Inv.	N.S.S.	30473	30937	30938	30758	21346X⑳	30481	.....	.....	30187
21035-5X	1.271"-19 Inv.	N.S.S.	30473	30937	30938	30758	21346X⑳	30481	.....	.....	30187
21036-3X	1.271"-19 Inv.	N.S.S.	30473	30937	30938	30758	21346X⑳	30479	30482	500595-8	30187
21036-5X	1.271"-19 Inv.	N.S.S.	30473	30937	30938	30758	21346X⑳	30479	30482	500595-8	30187
21037-3X	1.271"-19 Inv.	N.S.S.	30473	30937	30938	30758	21346X⑳	30481	.....	.....	30187
21037-5X	1.271"-19 Inv.	N.S.S.	30473	30937	30938	30758	21346X⑳	30481	.....	.....	30187
21038-3X	1.271"-19 Inv.	N.S.S.	30473	30937	30938	30758	21346X⑳	30479	30482	500595-8	30187
21038-5X	1.271"-19 Inv.	N.S.S.	30473	30937	30938	30758	21346X⑳	30479	30482	500595-8	30187
※21291X	1.331"-20 Inv.	N.S.S.	30762-1	30937	30938	30727	21348X⑳	30931	.....	.....	30074
※21293X	1.201"-20 Inv.	N.S.S.	30762-1	30937	30938	30727	21348X⑳	30931	.....	.....	30074
※21316X	1.271"-19 Inv.	N.S.S.	30762-1	30937	30938	30758	21346X⑳	30908	30482	500595-17	30187
※21317X	1.271"-19 Inv.	N.S.S.	30762-1	30937	30938	30758	21346X⑳	30931	.....	.....	30187
※21318X	1.271"-19 Inv.	N.S.S.	30762-1	30937	30938	30758	21346X⑳	30908	30482	500595-17	30187

① 1 required per Differential Assembly
② 2 required per Differential Assembly
③ See Applications Pgs. 2 & 3 for Specitic Vehicle Models
④ 4 required per Differential Assembly
⑥ 6 required per Differential Assembly
⑧ 8 required per Differential Assembly
⑩ 10 required per Differential Assembly
⑳ Includes a matched set of 2 Bevel Side Gears and 4 Bevel Pinion Mate Gears
※ New Part Number
N.S.S. Not Serviced Separately

The Story Behind the Spicer Thornton POWR-LOK Differential



Ten years ago Dana Corporation set up a development program to make a complete analysis and study of locking differentials. The general idea of this type of differential is not new, as they were used by some of the very early cars. We have several hundred different designs in our technical files.

We made a careful study of all types including full locking, bias or power dividing, over running, hydraulic, etc. This covered all methods of construction, variable leverage, bastard teeth, eccentric pinions, cranks, shoe and band brakes, cams and sliding pins, spiral, crossed helical and worm gears, over running clutches, ball, roller and sprag, escapement clutches, also both hydrostatic and hydrodynamic arrangements.

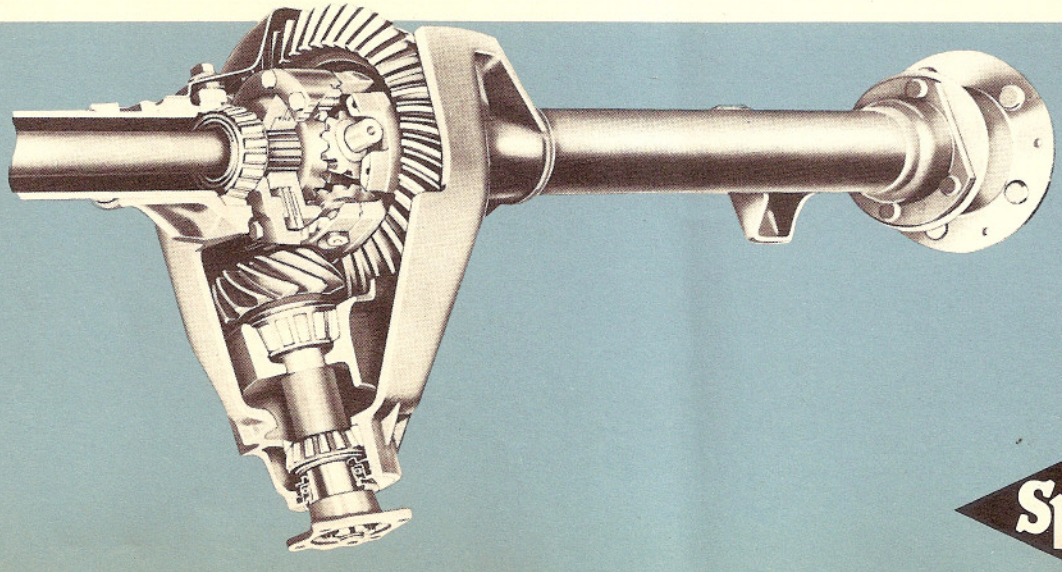
During the past eight years we have tested 25 different designs of various types and construction. Many of these were of our own design and construction, others were submitted to us by outside sources, some were already being used, and some were from foreign sources.

We found that the THORNTON POWR-LOK differential fulfilled all of our requirements, and in addition, had two more worthwhile features.

1. Capacity is increased over conventional differentials, as the load is divided between the gear teeth and the ~~cone~~ PLATE clutches.
2. Action is the same for both drive and coast loads, and forward and reverse driving.

We decided upon the THORNTON POWR-LOK design, and during the past two years scores of them have been on test with very satisfactory results.

The Thornton POWR-LOK Differential is interchangeable as a unit with present Spicer Differentials.



Spicer

The Mechanical Principles in THE Spicer THORNTON

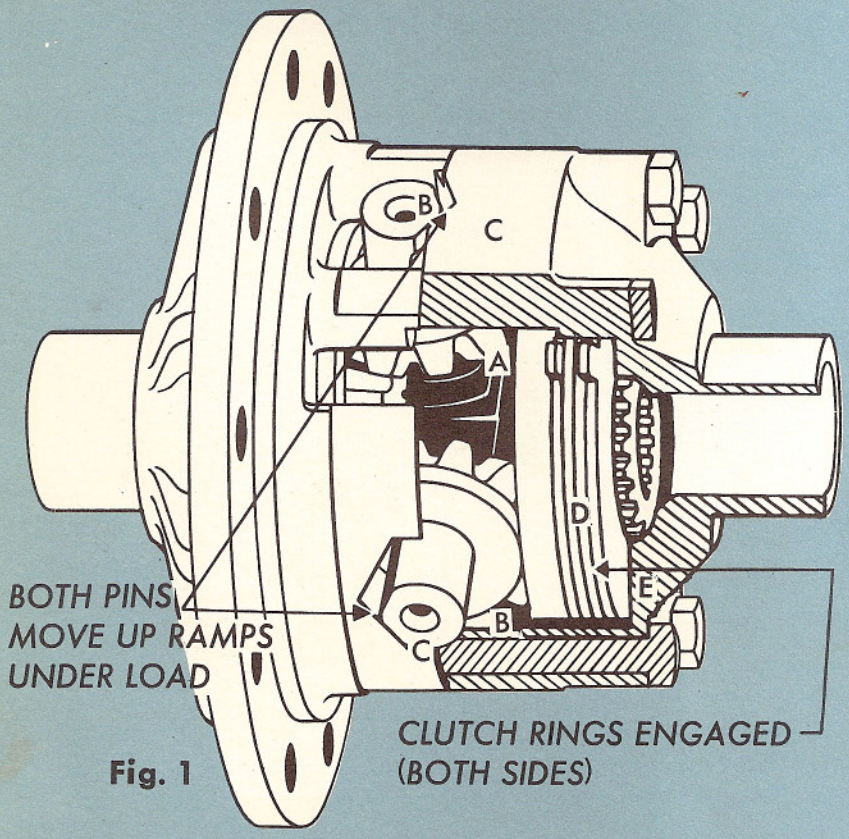
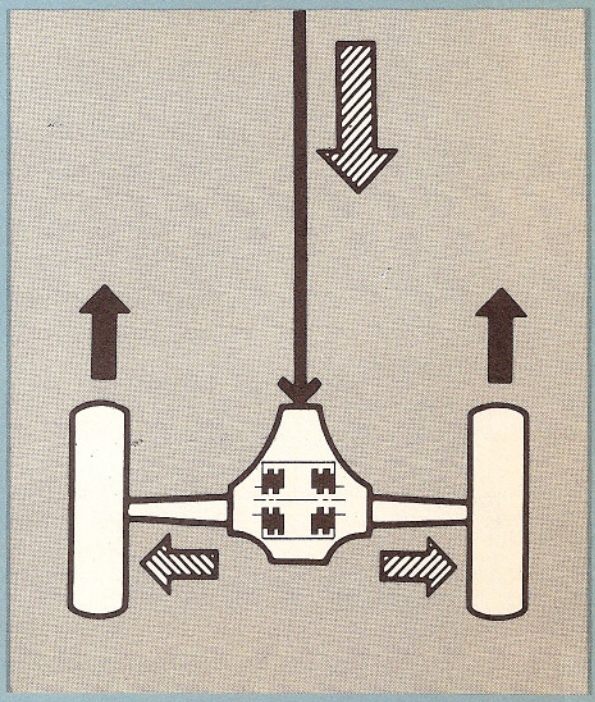


Fig. 1



The conventional differential, as used today, divides the load equally between both driving wheels. In this connection, it should be remembered that the conventional differential will always drive the wheel which is easiest to turn. This is a definite disadvantage under adverse conditions of driving where the traction of one wheel is limited.

The main purpose of the Thornton POWR-LOK differential is to overcome this limitation. The Thornton POWR-LOK will provide many times the torque of the slipping wheel to the driving wheel, thus permitting improved operation under all conditions of driving. In the Thornton POWR-LOK, the torque is transmitted from the differential case to the cross pins and differential pinions to the side gears in the same manner as torque is applied in the conventional differential.

The driving force moves the cross pins B (see fig. 1) up the ramp of the cam surfaces C, applying a load to the clutch rings D and restricts turning of the differential through the friction clutches E. This provides a torque ratio between the axle shafts which is based on the amount of friction in the differential and the amount of load that is being applied to the differential.

POWR-LOK DIFFERENTIAL

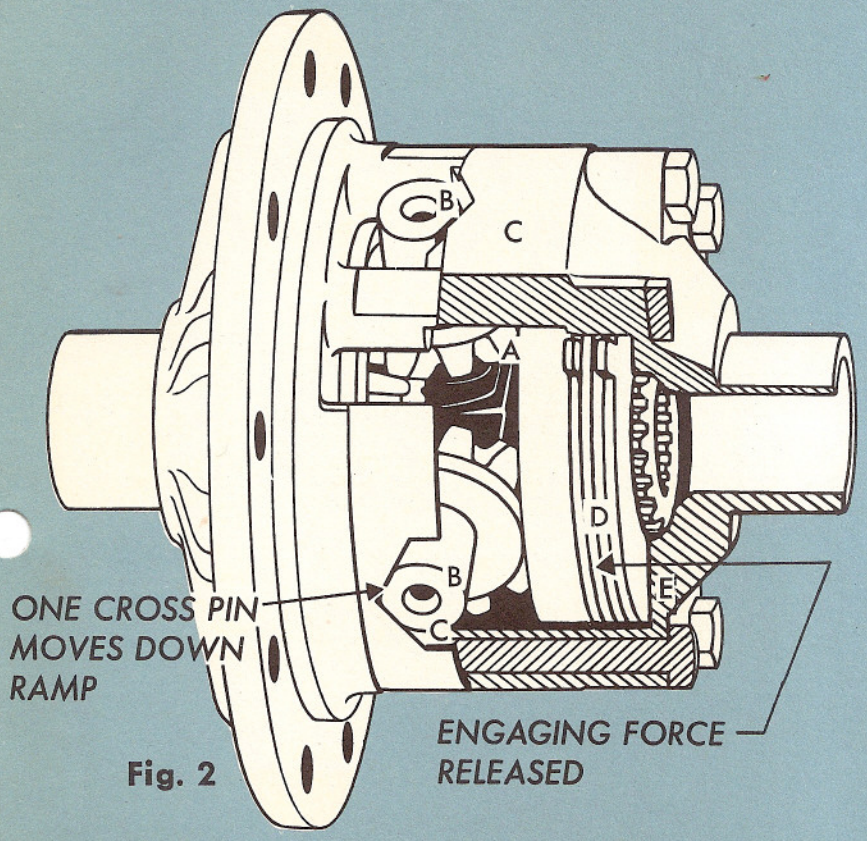
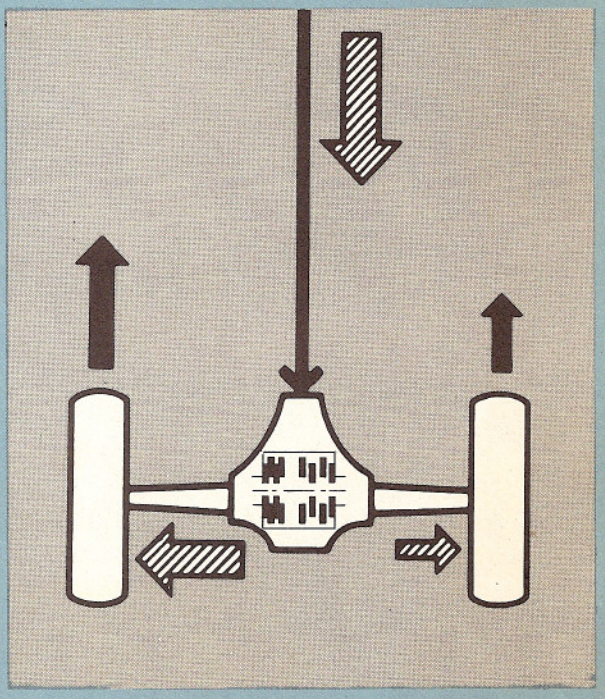
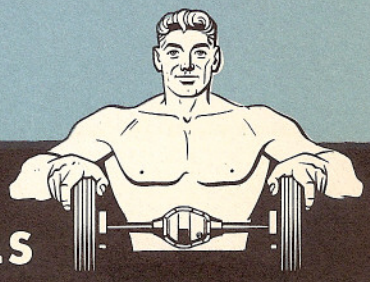


Fig. 2



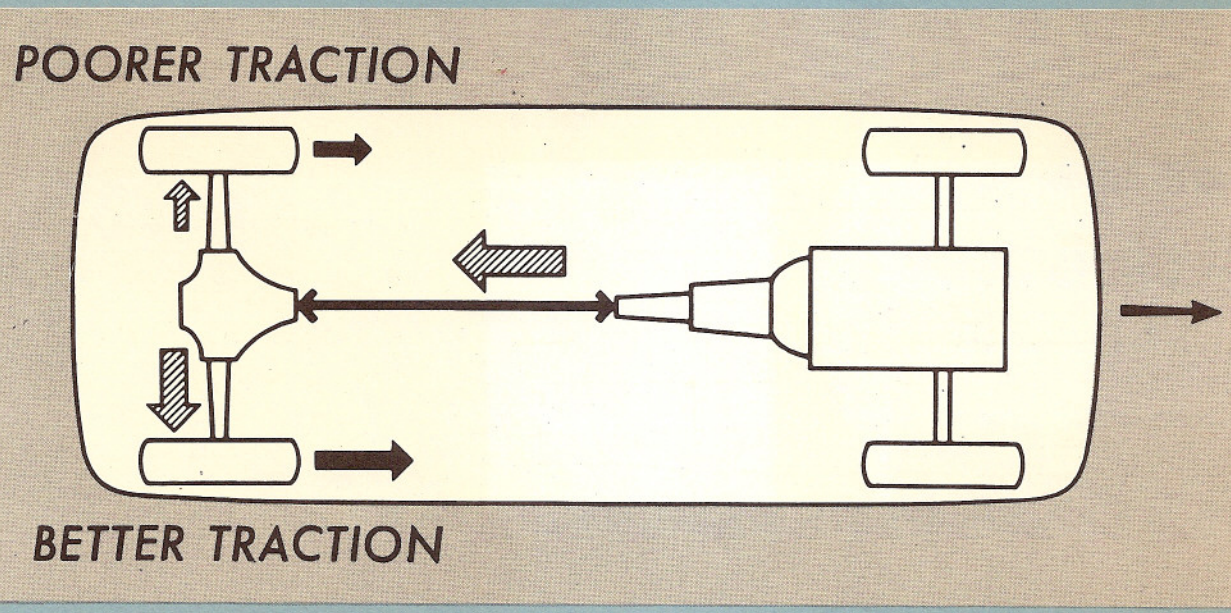
When turning a corner, this process is in effect partially reversed. The differential gears become a planetary gear set, with the gear on the inside of the curve becoming the fixed gear of the planetary. The outer gear of the planetary over runs as the outside wheel on the curve has a further distance to travel. With the outer gear over-running and the inner gear fixed, the pinion mates A (see fig. 2) are caused to rotate, but inasmuch as they are restricted by the fixed gear, they first must move pinion mate shafts B back down the cam surface C relieving the thrust loads on the plate clutches E. Thus when turning the corner, the differential, for all practical purposes, is similar to a conventional differential and the wheels are free to rotate at different speeds.

The engagement of the clutches in the Thornton differential provides many features in this unit that are not common in other types of locking differentials. On straight driving, the clutches are engaged and thus prevent momentary spinning of the wheels when leaving the road or when encountering poor traction. In turning a corner, the load is relieved from the clutch surfaces so that wear is reduced to a minimum.



POWER GEARED TO BOTH DRIVING WHEELS

ferential works in typical driving situations



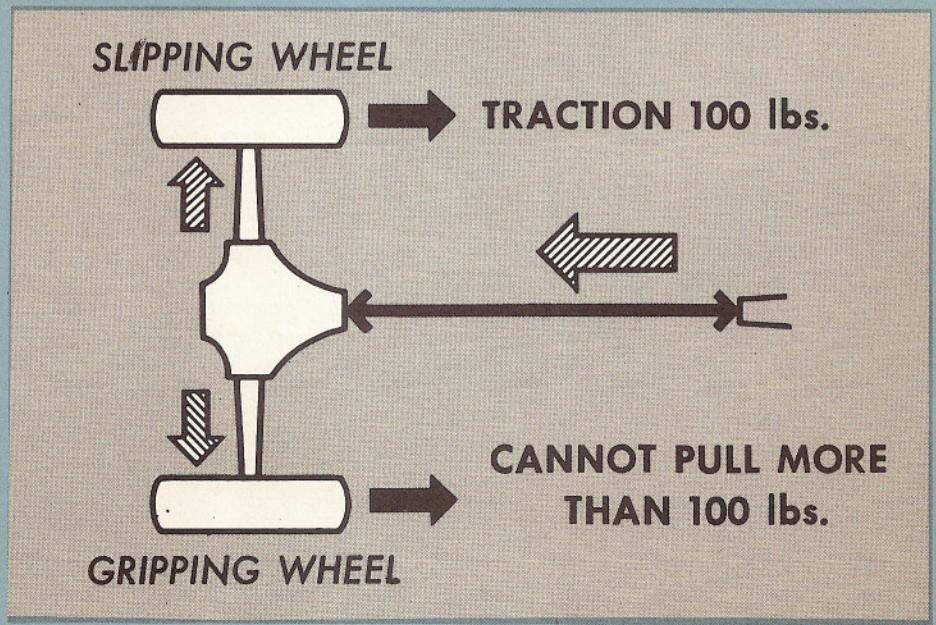
3 Power Flow with Poor Traction

When traction conditions under the rear wheels are dissimilar, the driving force with an ordinary differential is limited by the wheel with the *poorer* traction. Typically, in this situation, the wheel with the poorer traction spins, and the vehicle remains immobile. The POWR-LOK Differential enables the wheel with the *better* traction to apply the major driving force to the road. In this way the POWR-LOK equipped vehicle can operate in snow, ice, and mud which might stop a conventionally equipped unit.

In an emergency situation, when one rear wheel drops off the pavement, traction with the ordinary differential is limited to that of the wheel off the pavement. This wheel tends to spin, and when the pavement is regained, the car swerves as the momentum of the spinning wheel is absorbed. With the Thornton POWR-LOK the wheel on the pavement continues to drive the car, and the wheel on the shoulder *does not spin*. In this way complete vehicle control is maintained and there is no dangerous swerve.

COMPARATIVE
in starting a vehicle in snow,

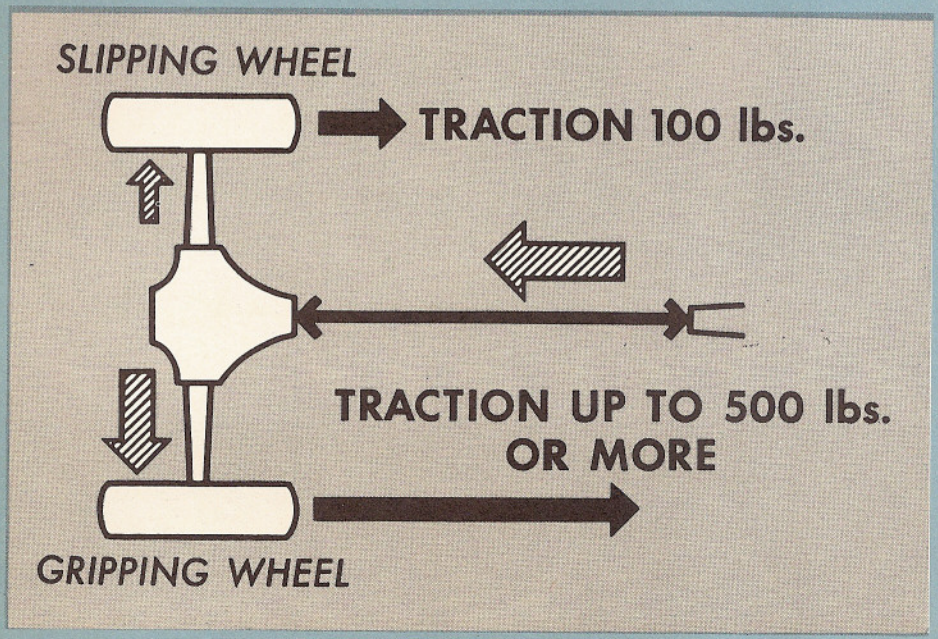
CONVENTIONAL DIFFERENTIAL



Snow at the curb presents a typical problem encountered by all types of vehicles in the winter months. This condition often offers traction on one wheel and no traction at the curb driving wheel. With the ordinary differential the curb wheel spins in the snow and the vehicle is stuck, as driving power to both wheels is equal and limited by the poor traction of the slipping wheel.

The Spicer Thornton POWR-LOK Differential

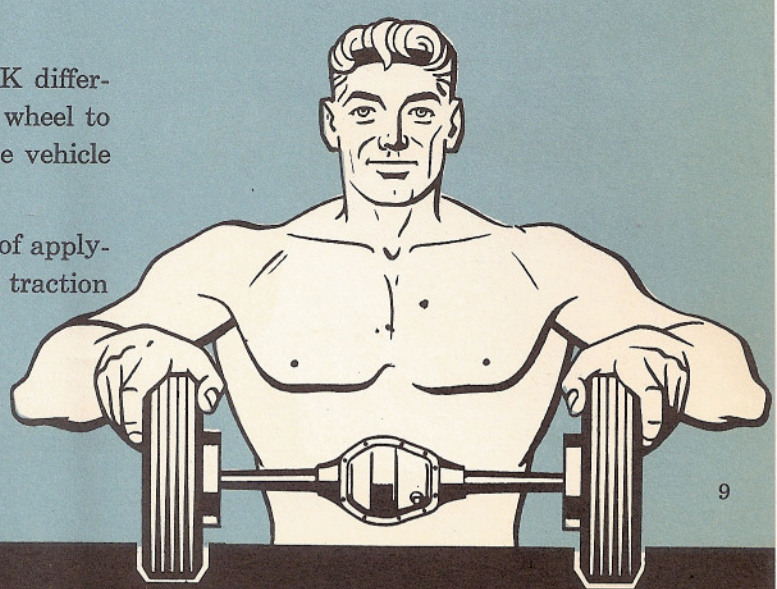
ACTIONS
ice, mud, sand, etc.



Spicer
THORNTON
POWR-LOK
DIFFERENTIAL

Under the same conditions the Thornton POWR-LOK differential applies many times the driving force of the curb wheel to the wheel on the street with the better traction and the vehicle starts normally.

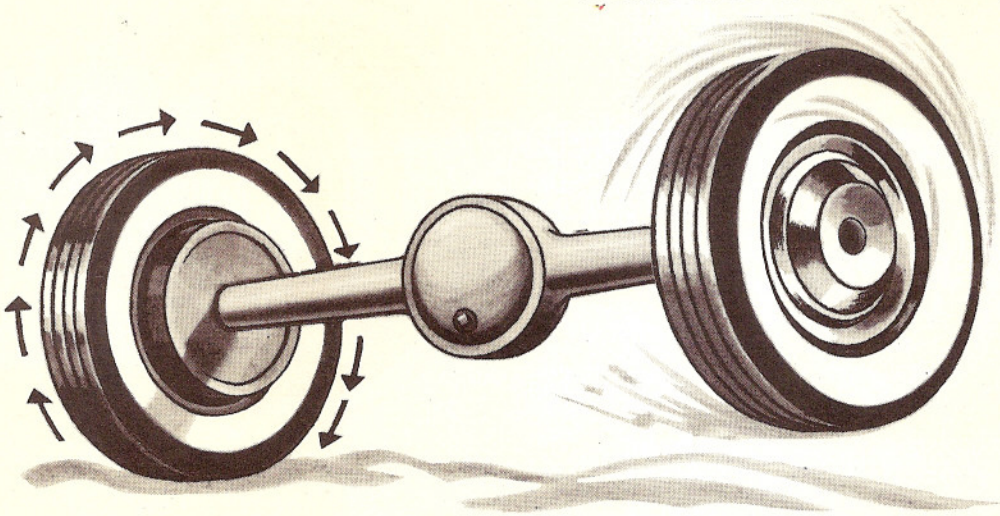
Similarly, the Thornton POWR-LOK's characteristic of applying the major driving force to the wheel with the better traction enables the vehicle to be operated in mud, sand and on ice which would stall a unit with an ordinary differential.

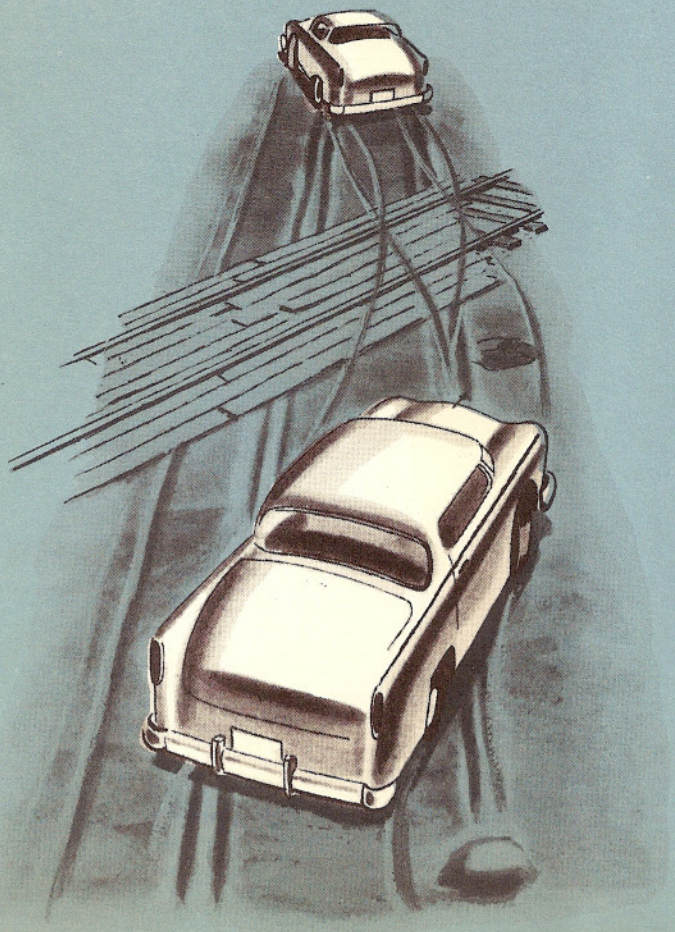


Locks Constant Power into *Both* Driving Wheels

COMPARATI
on rough roads and

Modern passenger cars with increasing horsepower and power-to-weight ratio present problems in high speed stability and handling. This problem has become more acute in recent years as the center of





ORDINARY DIFFERENTIAL

When a rear wheel is thrown into the air by a bump or obstruction and road contact is broken, the ordinary differential spins the wheel which rapidly gains momentum.

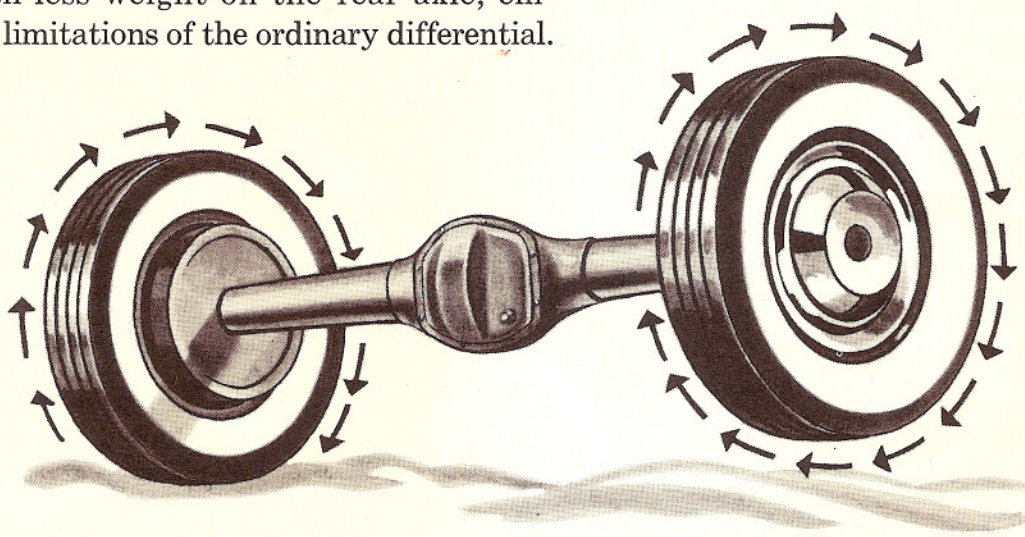
When this rapidly-spinning wheel hits the road surface, the sudden shock causes the car to swerve and the tire to scuff.

Spicer

VE ACTIONS
non-uniform surfaces

gravity of cars has moved forward.

This increased torque available at the rear wheels, coupled with less weight on the rear axle, emphasizes the limitations of the ordinary differential.

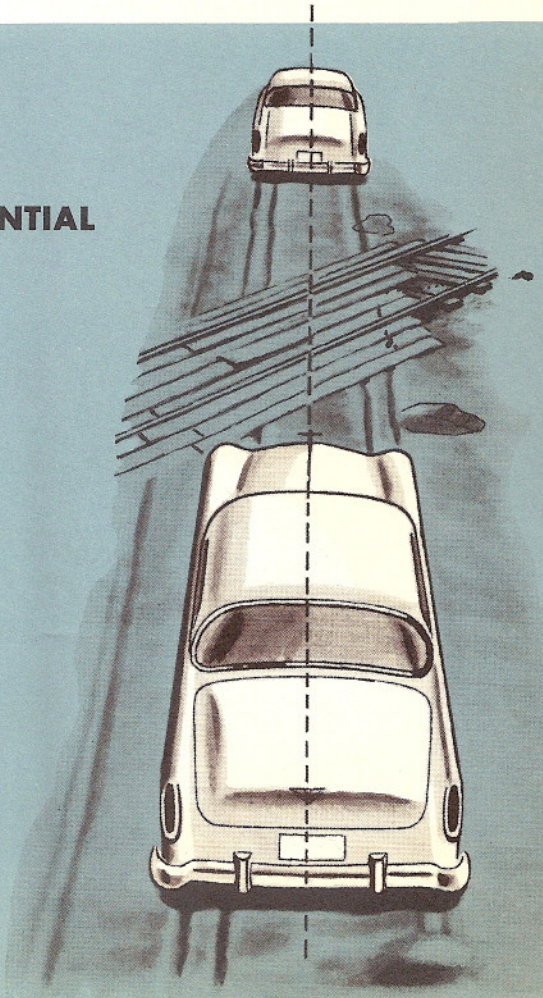


Spicer

THORNTON POWR-LOK DIFFERENTIAL

Bumps do not adversely affect wheel action when wheels are controlled by the POWR-LOK. The free wheel does not spin and gain momentum. There is no sudden wheel stoppage to cause car swerve or tire scuffing, and wheel hop is reduced.

These characteristics of the Thornton POWR-LOK differential contribute substantially to highway safety through improved high speed stability and handling of the vehicle.



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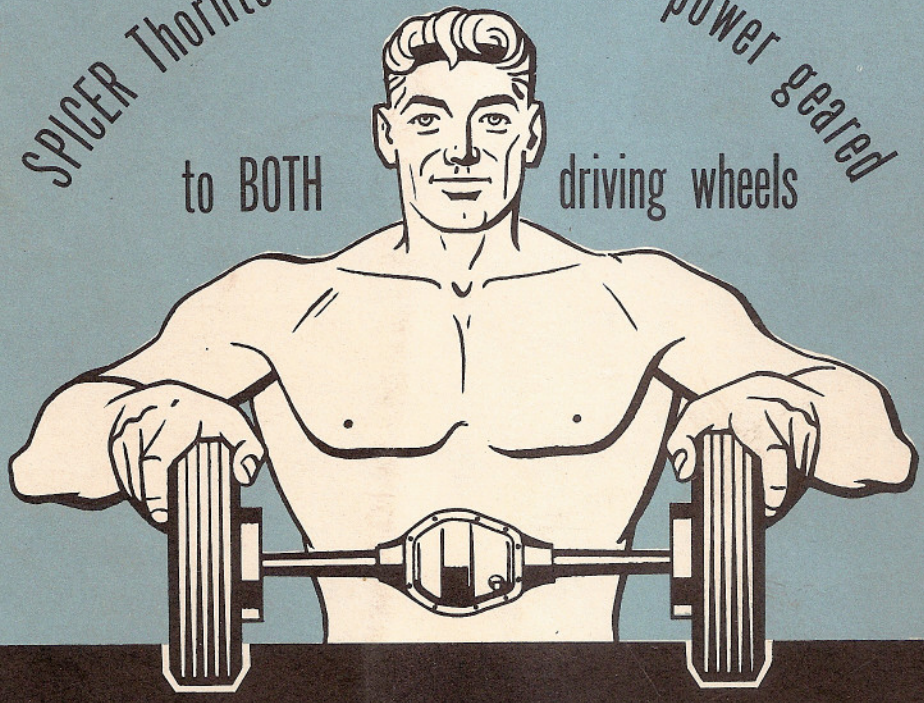
SPICER Thornton POWR-LOK keeps power geared to BOTH driving wheels



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