The CHRYSLER AUTOMATIC OVERDRIVE

HOW TO USE THIS EXCLUSIVE FEATURE

HOW IT OPERATES

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Courtesy: George Cox

FOREWORD

THE purpose of this booklet is to convey to you in an interesting and instructive manner the functions of the Chrysler Automatic Overdrive—a device which contributes not only to the pleasure of driving but which provides a new degree of operating economy as well.

The Airflow type of car has made possible higher road speeds than in the past. This, of course, means higher engine speeds. By using an overdrive which drives the axle over the engine speed, it is possible to get high road speeds with low engine speeds. The lower engine speeds show a marked saving in fuel, oil and engine wear and consequently greatly reduce the noises and disturbances usually associated with high speed driving.

Once you have experienced the sensation produced by this device, which is standard equipment in the Airflow Imperials and Custom Imperials and optional at slight extra cost in the Airflow Eights, you will marvel that a mechanism so simple in construction and operation can produce its many advantages.

HOW TO USE THE OVERDRIVE

THE Chrysler automatic overdrive is a set of gears placed back of the regular transmission gears which will reduce the engine speed at high car speeds. They are engaged automatically when the driver takes his foot from the accelerator pedal at a speed of 45 miles per hour or over and they disengage automatically when the driver takes his foot off the accelerator pedal at speeds below 37 miles per hour.

The car equipped with a Chrysler overdrive is driven exactly the same as the car you have been driving. *There is nothing new to learn.* In fact, the driver does not need to know that the car is equipped with an overdrive. If the driver wishes to accelerate quickly he simply keeps his foot on the accelerator until the car has reached the desired speed. The action of taking the foot from the accelerator pedal allows the overdrive to engage automatically. A lapse of time should be allowed before putting the foot on the accelerator again to allow the mechanism to engage. This time is about as long as the pause required in shifting gears. A very noticeable decrease in noise and a sense of eagerness of the car to increase in speed will be felt. But there is some loss in acceleration under these conditions.

A word of warning at this time is in order. The car will attain higher speeds than the driver is aware of and may approach corners more rapidly than the driver realizes if an eye is not kept on the speedometer until the driver becomes accustomed to the new sensation and lack of consciousness of car speed.

If it is desired to get high acceleration, to pass another car for instance, shift into second gear depressing the clutch pedal just as if there were no overdrive. After the acceleration has been complete shift back into high speed using the clutch as in a normal transmission.

As the car speed is reduced either by hill climbing or on the part of the driver, the overdrive will be in operation to speeds lower than the engaging speed until the foot is taken off the accelerator which allows the mechanism to automatically disengage into direct drive. This arrangement is particularly advantageous for it automatically gives the driver a free-wheeling condition with easy shifting at speeds required in city driving and definitely locks out the free wheeling action at high road speeds so that the engine can be used as a brake in cross-country driving.

There is an overdrive control button on the instrument board. This button in its forward or "in" position allows the overdrive to function as described above. In its outward or "pulled out" position it locks the transmission so that overdrive cannot be obtained and free wheeling is not functioning in any gear. This is a position which might be desirable for mountain driving in slippery weather.

This button should be operated at speeds below 35 miles per hour and the clutch pedal should be depressed in either pushing the button in or pulling it out.

The use of an overdrive on the Airflow Chrysler makes it possible to select two high speed ratios, one permitting better acceleration and better hill climbing in high gear, the other with the overdrive in operation adapts the gear ratio to high speed work with smoothness and economy. Using one ratio for these two conditions is in reality a compromise.

Since the overdrive engagement is governed by car speed, the overdrive may be used with second gear. Accelerate to 45 miles per hour in second gear, release the accelerator as before and the overdrive engages and you are now in overdrive second and the free wheeling function is locked out. A silent drive with an overall ratio of 4.5 to 1 is now effective which will give remarkable hill climbing and acceleration performance.

The following overall gear ratios can be obtained under the various conditions described above:

Ratios	Direct	Overdrive
High	4.3–1	3.03–1
2nd	6.41–1	4.51–1

The OVERDRIVE EXPLAINED

HOW CHRYSLER ENGINEERS SOLVED A MAJOR PROBLEM AND ACHIEVED AN ENTIRELY NEW STANDARD OF PERFORMANCE. » WHAT IT MEANS TO YOU IN PLEASURE, ECONOMY OF OPERATION AND LONG ENGINE LIFE

THE history of automobile transmission development has of necessity been one of compromises. The adaptation of the internal combustion engine to the self-propelled vehicle from the beginning required the use of an intermediate speed-reducing and torque-increasing mechanism. This function in the automobile is performed by the combination of the rear axle gearing and the transmission unit. The latter, however, has always been considered a necessary evil because of the requirements for starting from rest or heavy pulling at low speed. However, since it required manual operation on the part of the driver, it has been the aim of car designers to cover the greatest possible range of speed and load conditions by means of the fixed rear axle reduction alone. This limitation has led to a compromise which has a number of undesirable aspects.

In order to satisfy the demand both for rapid acceleration at low speeds and high maximum car speeds without resort to gear shifting and without excessive engine size, the maximum operating engine speed has been increased from year to year, until finally maximum engine speeds well over 4000 revolutions per minute have become common practice. This not only reduces engine life but results in excessive fuel and oil consumption at high road speed. In the past, only the unusual driver habitually drove at sustained high speed. However, the tremendous improvement which has been accomplished in comfort and safety in the modern automobile and the development of good highways has raised the average cruising speed to the point where sustained high engine speed is a normal condition of operation. This situation has had to be met by the provision of a greater range of transmission speeds from the engine to the driving wheels.

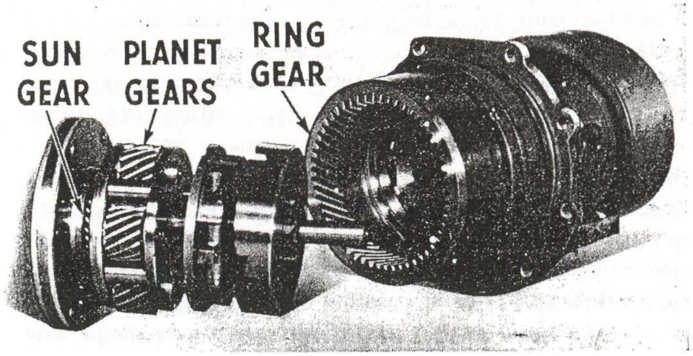
This problem has been a chronic one with automotive engineers; today it has become acute. Many attempts have been made in the past to solve this problem by such means as the addition of another manually shifted gear set in the transmission or by two speed rear axles. In every case, these previous attempts have failed because of noise, or lack of automatic control, which permitted driving the car in the wrong gear at the wrong time.

Chrysler engineering, after several years of intensive effort, is again a pioneer, this time in the adoption of the first successful answer to the overdrive problem, one which meets all the requirements of simplicity, quietness, reliability, and automatic operation.

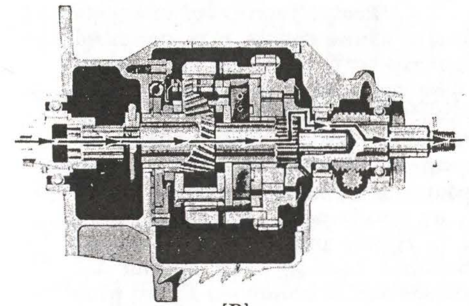
THE OVERDRIVE DESCRIBED

Referring to the sectional view of the overdrive transmission, shown at the bottom of page 7 [Illustration D], it will be seen that when the mainshaft is in the position shown, the teeth on its right end mesh with both the free-wheel cam and the centrifugal weight assembly. In direct drive [Illustration B], the flow of power is indicated by the broken arrow, being from the mainshaft, to the free-wheel cam, through the rollers to the free-wheel housing which is integral with the tail shaft.

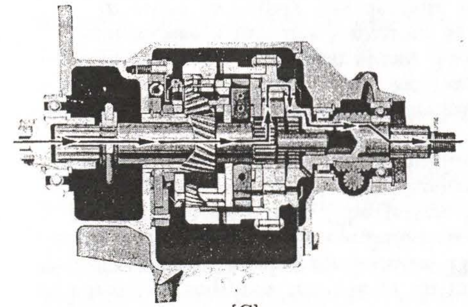
The overdrive is obtained with planetary gearing and the shift is accomplished by centrifugal weights. A sun gear [Illustration A], is mounted on the case and is attached to the cushion hub which prevents it from rotating.



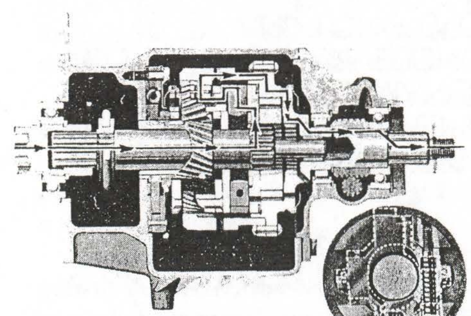
[A]
Automatic Overdrive Unit



[B]
Flow of Power in Conventional Drive—No Overdrive or Free wheeling



[C]
Flow of Power in Free wheeling



[D]
Flow of Power in Overdrive

The sun gear is surrounded by five pinions or planet gears on needle bearings which are mounted in a suitable cage. The pinions mesh with an internal gear which is riveted to the tail shaft assembly. A notched drum is attached to the pinion cage. Examination of the gearing will show that in direct drive this drum rotates more slowly than the centrifugal weight assembly.

Each of the two centrifugal weights is held inward by a coil spring until a speed of 45 m. p. h. is exceeded. At this time centrifugal force overcomes the resistance of the springs and the weights tend to fly out. However, the outer surfaces of these weights are so curved that they cannot enter the notches as long as they are rotating faster than the drum.

But just the instant the foot is lifted from the accelerator pedal, the engine, mainshaft and weight assembly slow down together. As soon as their speed reaches that of the drum, the weights are able to insert themselves in the closely fitting notches.

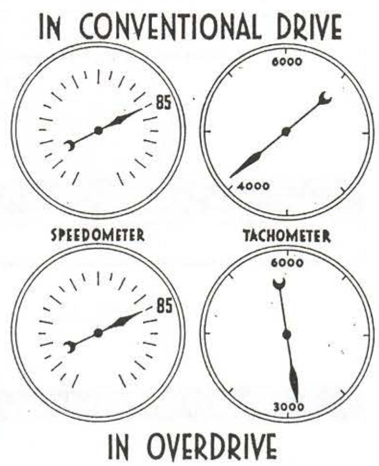
The mechanism is now locked in the overdrive. The "cushion hub" previously mentioned softens the shock of the shift so that you have to listen hard to hear it. The path of power in overdrive is indicated by the broken arrow in Illustration [D].

Looking at the centrifugal weight pictures, it will be noted that a spring-backed lock ball helps to hold the weights in either their inner or outer position. This feature prevents "wandering" of the weights at some critical speed, but it also causes the overdrive to cut in at 45 m. p. h. and cut out at 37. When the weights are at their inner position, both the lock ball and the main coil spring are resisting centrifugal force, requiring, in this case, a speed of 40 m. p. h. to overcome both. But when the weights are in their outer position, the spring must overcome both the lock ball and centrifugal force, which means that centrifugal force must drop far below its former value before the spring is able to overbalance both this force and the resistance of the lock ball.

Both free-wheel and overdrive are locked out by sliding the mainshaft to the right.

ADVANTAGES IN ENGINE LIFE

The tremendous advantage of the overdrive in conserving engine life is readily apparent from the fact that it reduces engine speed thirty per cent for a given car speed. This means that at sixty-five miles an hour the engine is running at a speed corresponding to forty-five miles an hour in conventional direct drive. Furthermore, the overdrive automatically limits the maximum possible engine speed. For example, a car which in conventional drive has a top speed of eighty-five miles



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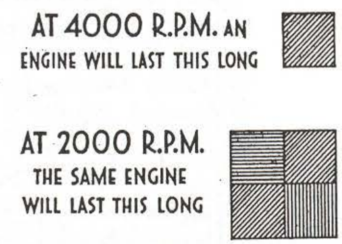
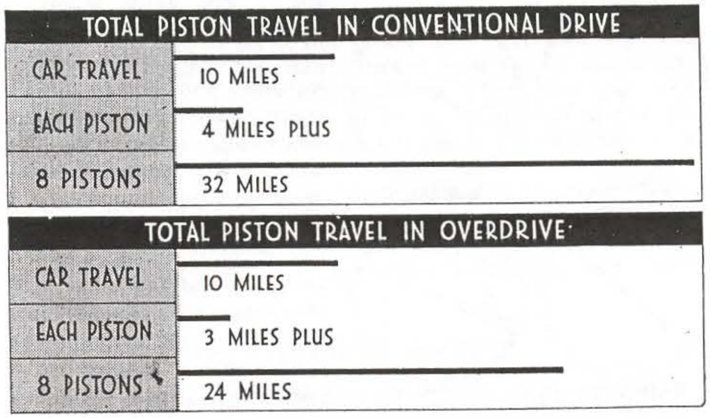
per hour at 4000 engine revolutions per minute will, in overdrive, have a top speed of ninety miles per hour, and an engine speed of 3000 revolutions per minute. At first glance it appears paradoxical that the engine should be slowed down and the maximum car speed increased, yet the change in gear ratio is the simple explanation for this performance.

The power required to propel a car at a given speed is fixed by such considerations as rolling friction, and wind resistance. What we do when we drive at a constant speed is to adjust the power output of the engine by means of the throttle until it equals the power required to propel the car at that speed. If we open the throttle wide, the car will accelerate until the power developed and the power required again come into balance.

It is safe to say that the life of a given engine is inversely proportional to the square of the operating speed. That is, at 4000 revolutions per minute the life would be roughly ¼ of what it would be at 2000 revolutions per minute. The reason for this is that the loads on the bearing surfaces increase as the square of the speed. The higher the load on a bearing the greater is the friction. Friction not only means waste of power but manifests itself as heat. Resistance of a bearing surface to wear and abrasion decreases rapidly as the temperature increases. Rapid increase in bearing friction with increased load and speed means a terrific acceleration in the rate of wear.



The reduction in engine speed brought about by the overdrive also means a tremendous gain in piston, piston ring, and cylinder bore life. It is easy to lose sight of the fact that in the last analysis, the car is actually propelled by the pistons of the engine. Thus, there is a definite relation between the distance travelled by the pistons and that travelled by the car. In conventional drive each piston travels over four miles for each ten miles of car travel or a total piston travel for an eight-cylinder engine of over thirty-two miles for each ten miles of car travel. Considering the tremendous forces acting on the pistons, one begins to appreciate the possibilities of wear in this vital engine part, also, the tremendous advantage of the over-



drive which reduces the total piston travel to twenty-four miles plus for each ten miles of car travel or a reduction in piston travel equal to the entire distance travelled by the car.

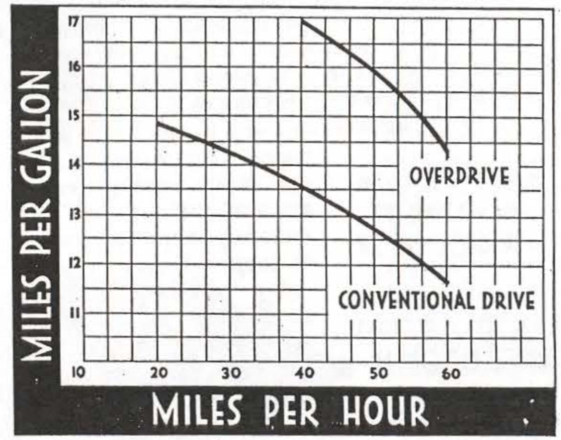
ADVANTAGES IN ECONOMY

From what has already been said about the reduction in friction due to reduced engine speed, it is apparent that the overdrive also makes for increased economy of operation. There are a number of other considerations which are fully as important and which altogether mean a terrific cumulative saving in fuel and oil consumption.

It is not generally realized that the greatest inherent loss in engine efficiency is due to operation under conditions which require only a fraction of the engine's power capacity. As we close the throttle of an engine running at a fixed speed in conventional drive, we not only do not decrease the friction losses, but we actually increase the parasitic work done by the engine due to the low vacuum under which the engine draws in the fuel mixture. Thus, at ordinary car speeds at which the actual power required to drive the car is very much less than the full throttle power of the engine, the parasitic losses become as great and even exceed the useful power.

Another source of gain available with overdrive, lies in reduction of losses involved in such accessories as fan and muffler. These losses tend to increase roughly as the cube of the speed. If a fan consumes one horsepower at 2000 revolutions per

minute, it would take 8 horsepower at 4000 revolutions per minute. Thus a thirty per cent reduction in engine speed effected by the use of the overdrive means a reduction of fifty to sixty per cent in such parasitic losses at a given car speed.



Tests conducted by Chrysler engineers have established a remarkable fuel economy factor for the overdrive.

Using the Chrysler Imperial, a car of 323.5 inches cubic piston displacement, 130 horsepower, and 8 cylinders $3\frac{1}{4}$ by $4\frac{7}{8}$ inches without overdrive, it was found possible to get 14.9 miles to the gallon at 20 miles an hour; 14.4 miles at 30 miles an hour; 13.7 miles at 40 miles an hour and 13.1 miles at 50 miles an hour. Demands on horsepower are very large at speeds of upwards of 50 miles an hour and the curve drops sharply. Nevertheless at 60 miles an hour the Imperial got 11.8 miles per gallon.

With the Chrysler overdrive, the first test was conducted at 40 miles an hour. The remarkable figure of 16.9 miles per gallon was obtained at this speed, or two miles a gallon more than at 20 miles in conventional drive. At 50 miles an hour the reading was 15.9 miles per gallon, still considerably higher than at 20 miles without the overdrive.

At 60 miles an hour, a speed that "eats up" fuel in conventional drive, the Chrysler Imperial got 14.3 miles per gallon with the overdrive in operation, or within .6 miles per gallon

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Chrysler "Overdrive" . . . Continued from page 47

are able to insert themselves in the closely fitting notches. The mechanism is now locked in the overdrive. The path of power in overdrive is indicated by the black arrow. The "cushion hub" previously mentioned softens the shock of the shift so that you have to listen hard to hear it. It also removes the last vestige of noise from the gearing.

Looking at the centrifugal weight pictures, it will be noted that a spring-backed lock ball helps to hold the weights in either their inner or outer position. This feature prevents "wandering" of the weights at some critical speed, and it also causes the overdrive to cut in at 40 m. p. h. and cut out at 35. When the weights are at their inner position, both the lock ball and the main coil spring are resisting centrifugal force, requiring, in this case, a speed of 40 m. p. h. to overcome both. But when the weights are in their outer position, the spring must overcome both the lock ball and centrifugal force, which means that centrifugal force must drop far below its former value before the spring is able to overbalance both this force and the resistance of the lock ball. A walking beam (not shown) connects the two weights so that they act in unison.

Both free-wheel and overdrive are locked out by sliding the mainshaft to the right.

It is important to note that if the driver wishes to stay in direct drive while exceeding a speed of 40 m. p. h. all he has to do is be careful not to allow engine speed to drop to 30 per cent below propeller shaft speed. If he wishes to slow down for traffic or a turn, he lifts his foot enough to allow the car to free-wheel but with engine racing somewhat instead of idling. The change to overdrive does not occur until engine speed has dropped 30 per cent below propeller shaft speed.

Lubrication of the unit is supplied by the transmission. To add lubricant, remove transmission oil level plug and fill to proper level. This will automatically take care of the overdrive. However, if the overdrive unit is dismounted or drained, the oil level plugs should be removed from both transmission and overdrive. Fill the transmission to proper level, then fill the overdrive until lubricant flows out the oil level hole in the transmission.

From pg 12-12

of the figure for 20 miles an hour without Chrysler's latest exclusive device.

It is a matter of common observation that oil consumption increases very rapidly with car speed. There are two basic reasons for this. In the first place, the higher the engine speed, the greater the amount of oil circulated by the pump. This means an increased throw-off from the crankshaft; also, because of the greater centrifugal force with increasing speed, more of the oil is thrown into the cylinder bores. The amount of oil that is pumped past the pistons depends upon the ability of the piston rings to scrape the oil off the cylinder walls and back into the crankcase. The higher the piston speed, the greater is the pressure on the oil built up ahead of the rings. This means that more oil will leak past the rings into the combustion chamber. The result is not only increased oil waste, but greater carbon deposition from the burning of the oil.

ADVANTAGES IN OPERATING COMFORT

The outstanding impression of the passengers of a Chrysler Airflow car is the complete absence of engine noise at high speeds when the overdrive is operating. If we analyze the origin of noise, we find that it represents the dissipation of energy. Thus, just as the waste of power due to friction is dissipated in the form of heat, so do the forces which produce friction generate noise and vibration, which are other forms of energy dissipation. A typical example is the case of fan noise which may be said to increase in very much the same proportion with speed as does the power required to drive it. Reduction in engine speed, which the overdrive achieves, especially at high car speeds, by eliminating so much of the power losses, at the same time cuts down the volume of noise tremendously.

No small part of this contribution to quietness is due to the inherent silence of the overdrive mechanism itself. Instead of being conscious that the overdrive gear is engaged, the passenger gets the impression, in going from conventional to overdrive, that he is going from gear drive to direct drive.

The addition of this simple overdrive mechanism puts the finishing touch to the Chrysler Airflow car, which marks the greatest recent advance in the art of individual transportation. At one stroke it makes possible greater speed at lower cost and the elimination of all strain and fatigue both to passengers and engine, and can be used at will by the driver without any addition of physical effort. In other words it is humanly automatically controlled.

NOTE: The article "Chrysler 'Overdrive'" was incomplete in the December issue due to a slight error, therefore, the short remainder is copied here
(from page 47 Motor 1934 or 18-12 of Newsletter Dec. '76)

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