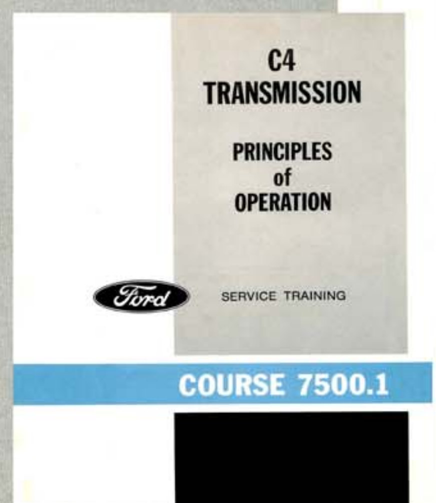
C4 TRANSMISSION

DIAGNOSIS, ADJUSTMENT and LIGHT REPAIR

And



FORD MOTOR COMPANY SERVICE TRAINING

COURSE 7501.3

Ford C4 Transmission Service Training (Course 7500.1 and 7501.3)

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Disclaimer

C4 TRANSMISSION

PRINCIPLES of OPERATION

Ford

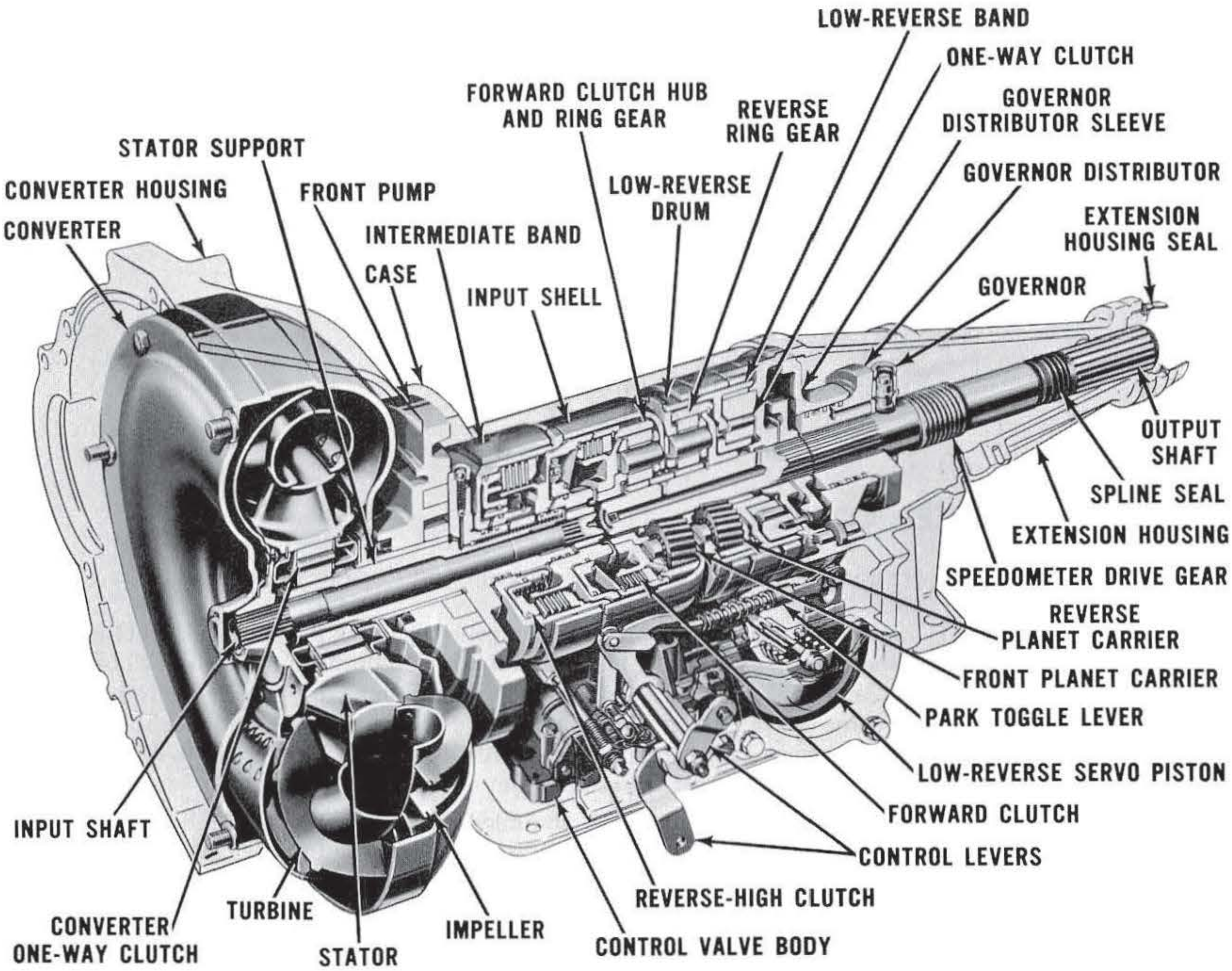
SERVICE TRAINING

COURSE 7500.1

C4 AUTOMATIC TRANSMISSION

This transmission is basically the same as earlier Ford automatic transmissions. It combines (1) a fluid torque converter with (2) a planetary gear train, and it controls the gear train ratios with (3) an automatic hydraulic control system.

The construction and the principles of operation of these three systems are covered in the following pages.



GEAR RATIOS	FIRST 2.46:1	HIGH 1.00:1
	SECOND 1.46:1	REVERSE 2.20:1
CONVERTER RATIO (STALL)	2.10:1 AVERAGE	

TORQUE CONVERTER OPERATION

In construction and operation, the torque converter is typical of all Ford torque converters.

The torque converter consists of three main parts: the Impeller (pump), the Turbine, and the Stator. The impeller is driven by the engine crankshaft through a flywheel mounted on the engine crankshaft. The turbine, which is mounted on the input shaft, is driven by the fluid pumped into it by the impeller. The stator is mounted on a one-way clutch. All of these parts are enclosed in a fluid-filled housing. The transmission hydraulic control system keeps the converter full of fluid and under pressure, when it is operating. It also provides a continuous flow of fluid in and out of the converter.

The Impeller, or pump, consists of curved blades mounted around the inside of a housing which is driven by the engine. An inner ring locks the blades in place and forms fluid passages. As the impeller rotates, fluid is forced through the curved fluid passages and into the turbine.

The Turbine, or driven member, is similar to the impeller except that it has blades curved in the opposite direction to the impeller blades. Fluid from the impeller strikes the turbine blades and causes the turbine shaft to rotate in the same direction as the impeller. The torque applied to the turbine is proportional to the velocity of the fluid flowing through it.

The fluid leaving the turbine returns to the impeller by a third set of blades known as the Stator. The stator is attached to the stator support on the transmission case by a one-way clutch which permits the stator to rotate only in the same direction as the impeller. The clutch locks the stator to the fixed stator support to prevent counterclockwise rotation.

Let's take a look at the torque converter operation under various driving conditions. Let's start with the car standing still at a red light, with the engine running at normal (hot) idle, and the selector at the Drive position.

The converter housing and impeller is turning at engine crankshaft speed. Centrifugal force acting upon the fluid rotating along with the impeller causes it to flow outward as shown. The fluid flows through the turbine and stator and back to the impeller. The turbine is stationary, because it is locked mechanically to the rear wheels and the fluid flow forces acting on the turbine are not strong enough to turn the rear wheels.

TORQUE CONVERTER OPERATION – Continued

The turbine blades are curved to produce the greatest practicable change of direction in the fluid flowing through it. When the turbine is stationary, and at low rotary speeds, the fluid flow leaving it is aimed for a head-on collision with the rotating impeller blades. To prevent this collision, stator blades are installed between the turbine outlet passages and the impeller inlet passages. The stator blades are locked against counterclockwise rotation by a one-way roller clutch. The stationary stator blades force the fluid to make a U-turn and flow back into the impeller at an angle that helps impeller rotation.

Let's return to our car at the red light. Let's say the light turns green, and the driver depresses the accelerator pedal to drive off. As the throttle is advanced, engine and impeller speeds increase rapidly, while turbine speed increases slowly with car road speed. This difference in impeller and turbine speeds permits the impeller to build up the velocity of the fluid flow through the turbine and stator and back into the impeller. This flow is referred to as the vortex flow.

This build-up in the vortex flow velocity causes a greater torque to be applied against the turbine than the engine is applying against the impeller. At high impeller speed and low turbine speed, the vortex flow velocity is the sum of the impeller produced velocity plus the velocity of the fluid returning from the turbine and stator. In the typical Ford torque converter, engine torque is multiplied 2.1 times maximum when the turbine is stationary (stall condition). This increase in vortex flow velocity is made at the expense of turbine rotation. The turbine is turning slower than the impeller. This can be compared to a gear reduction in which torque at the output shaft is multiplied, but output shaft speed is reduced.

This vortex flow is not the only fluid force trying to turn the turbine. The vortex flow leaving the impeller is not only flowing out of the impeller at high speed, but is also rotating faster than the turbine. As this rotating fluid strikes the slower turning or stationary turbine, it exerts a turning force against the turbine. This is referred to as the rotary flow.

As the turbine begins to rotate and steadily picks up speed, the vortex flow is steadily losing speed because of the steadily increasing centrifugal force acting against the flow through the turbine. The rotating impeller produced a centrifugal force in the fluid which caused it to flow from the center outward. The same centrifugal force is acting in the rotating turbine trying to prevent the fluid from flowing inward. As the vortex flow slows down, torque multiplication is reduced.

Along with this steady increase in turbine speed and decrease in vortex flow speed, there is a continuous change in the angle at which the fluid leaves the turbine. When turbine speed reaches about 9/10 impeller speed, the flow leaving the turbine strikes the back side of the stator. At this point, the stator clutch unlocks and permits the stator to rotate clockwise. The converter is now in its coupling phase and torque multiplication has stopped. The converter is now merely transmitting engine torque from impeller to turbine.

TORQUE CONVERTER OPERATION – Continued

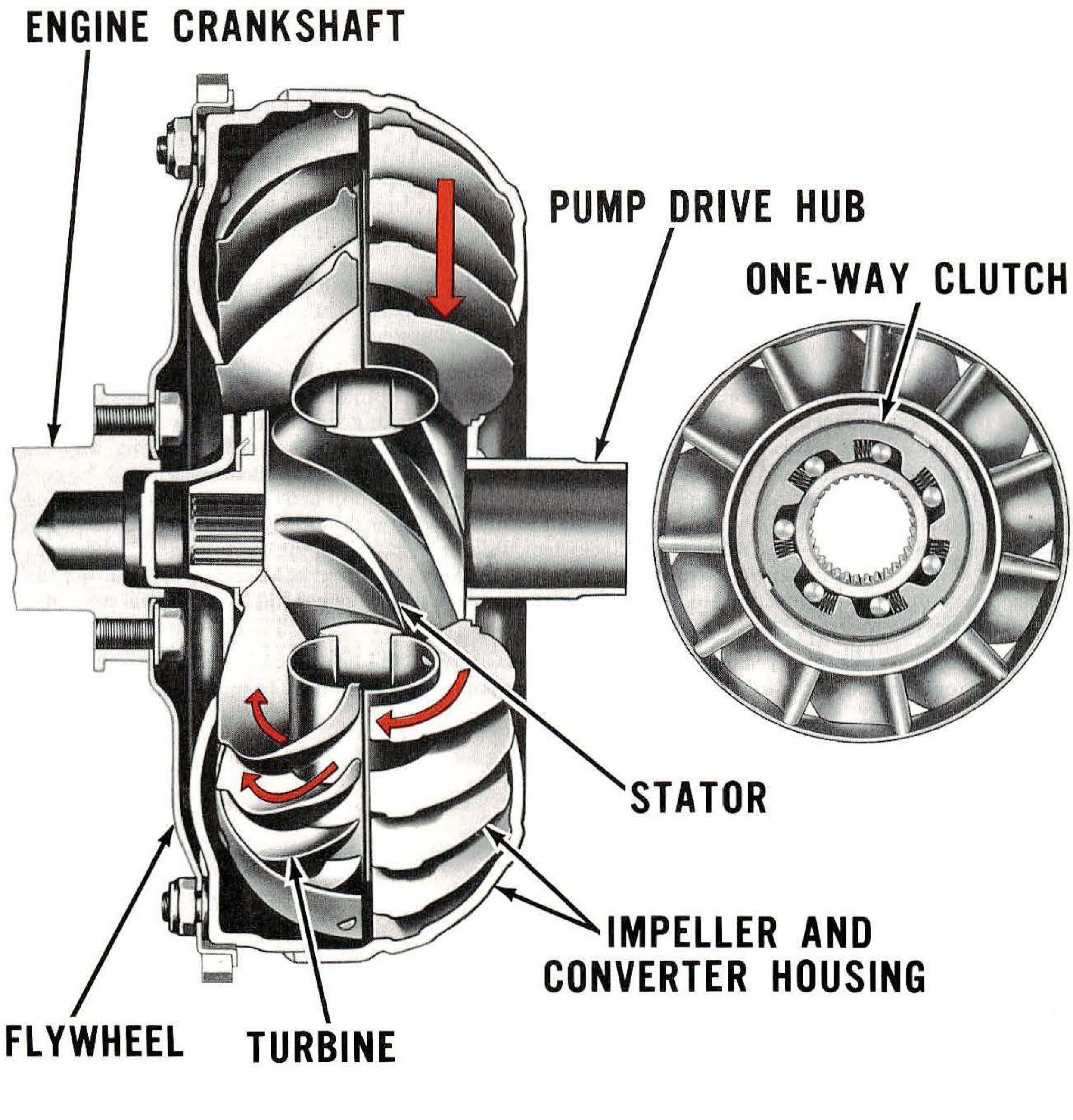
This coupling phase is reached when input torque and output torque requirements come near enough to balance so that the turbine can run at 9/10 impeller speed. This means that, at a light-throttle start, the coupling point is reached in a shorter time and a lower road speed than it would at a heavier throttle start. At the heavier throttle, it will take a longer time and a higher road speed before the turbine comes up to 9/10 of impeller speed.

Let's return to our car driving off on the green light. We are now cruising at steady throttle, at 45 mph. Ahead we see another traffic light about to go red, so we get off the accelerator pedal. The rear wheels are now driving the engine. In the converter, the turbine becomes the driving member and the impeller the driven member.

Let's discuss some aspects of the converter that we may have missed. Since vortex flow speed is governed by the difference between impeller and turbine speed, the torque converter automatically adjusts converter input to drive shaft torque requirements.

When the drive shaft torque requirements become greater than the engine output torque, the turbine slows down and causes an increase in vortex flow velocity and thereby an increase in torque multiplication. This automatic adjustment between torque input and output permits the converter to absorb the shock of sudden ratio changes (gear shifts) in the planetary gear set, especially at the lower road speeds.

If we are driving a Ford car and cruising at 30 mph in high gear, and suddenly depress the accelerator pedal to less than a full-throttle downshift position, we hear the engine speed increase rapidly, while the road speed will increase somewhat more slowly. In this case, it is not entirely accurate to say that the converter is slipping. There is, of course, some slippage in the converter at all times. It is more accurate, in this instance, to say that the torque converter has automatically adjusted itself to produce a greater engine torque multiplication to increase drive shaft speed. Torque multiplication can occur in the converter only when the turbine rotates at less than 9/10 impeller speed.



TORQUE CONVERTER OPERATION

GEAR TRAIN POWER FLOW

FIRST GEAR D

In first gear D, the forward clutch and the one-way clutch are applied. Engine power flows through the torque converter to the transmission input shaft, to the forward clutch cylinder, across the forward clutch plates, to the front unit ring gear hub, and then to the ring gear.

The ring gear rotates the front planet gears. The planet carrier, which is splined to the output shaft, has a tendency to remain stationary. This causes the front planet pinions to rotate clockwise and the sun gear to rotate counterclockwise. Counterclockwise rotation of the sun gear causes clockwise rotation of the planet pinions in the reverse planet carrier. With the reverse planet carrier held by the one-way clutch (and reverse band in manual low), the output shaft ring gear is forced to rotate clockwise by the reverse planet pinions at a reduction in speed. Output shaft ring gear rotation is transferred to the output shaft directly by the output shaft hub. This output shaft rotation requires that the front planet carrier rotate at the same speed and in the same direction (clockwise), since it is splined to the output shaft. Consequently, the front ring gear and planet assembly are rotating in the same direction (clockwise), but the planet carrier is rotating at a slower speed than the ring gear. As a consequence, the front planets are, in fact, turning clockwise, as previously indicated.

This clockwise rotation results in the counterclockwise rotation of the sun gear. The resultant gear ratio is a combination of the ratios provided by the front and reverse planet assemblies.

The input to output ratio in first gear is 2.46:1.

FIRST GEAR 1

In first gear 1, the low and reverse band is applied. The band application makes engine braking possible. In first gear D, the car can freewheel.

SECOND GEAR

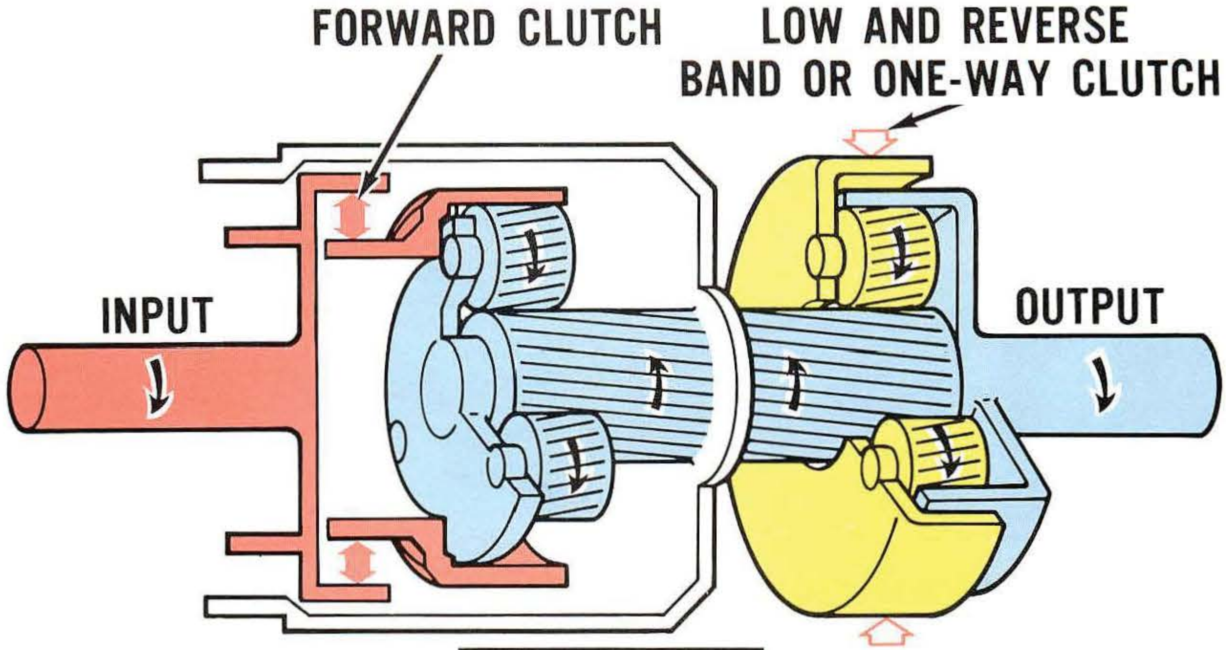
In second gear, the forward clutch and the intermediate band are applied. Engine power flows from the torque converter turbine to the transmission input shaft, to the forward clutch cylinder, across the forward clutch plates to the front planetary unit ring gear hub, and then to the front unit ring gear.

The ring gear rotates the planet gears and forces them to walk around the stationary sun gear. As the planet gears walk around, they take the planet carrier with them and the planet carrier drives the output shaft. The planet carrier is splined to the output shaft.

The sun gear is held stationary by the intermediate band, which is applied against the reverse and high clutch drum. The reverse and high clutch drum is locked to the input shell, and the input shell is locked to the sun gear.

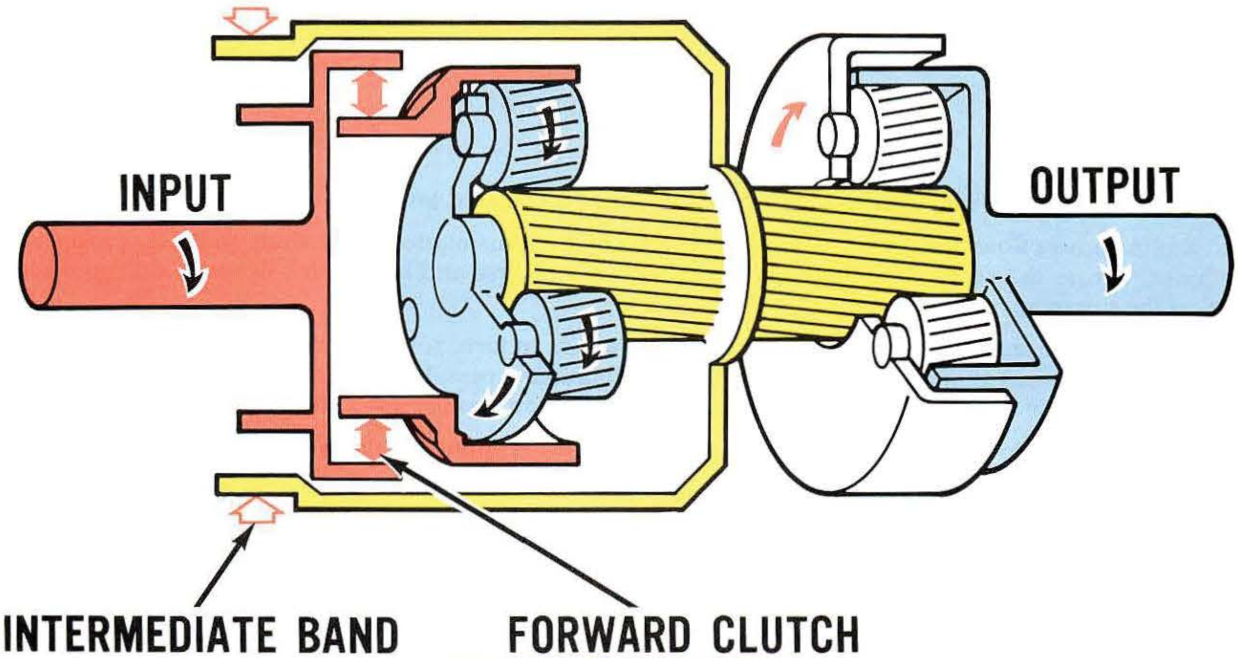
The gear action in second gear is that of a simple planetary gear set in reduction. This ring gear drives, the sun gear is held, and the load is on the planet gear carrier.

In second gear, the input to output ratio is 1.46:1.



FIRST GEAR

INPUT — OUTPUT — NOT WORKING — HELD BY BAND



SECOND GEAR

GEAR TRAIN POWER FLOW

GEAR TRAIN POWER FLOW — Continued

HIGH GEAR

In high gear, both clutches are applied. With both clutches applied, both the front unit ring gear and the sun gear are locked to the front clutch cylinder. Since the ring gear and the sun gear must now turn at the same speed and in the same direction, all tooth-by-tooth gear rotation in the gear train stops, and the gear train revolves as one piece.

Engine power flows through the torque converter to the transmission input shaft and to the forward clutch cylinder. Here the engine power flow splits. A part of the power goes across the forward clutch plates to the front ring gear; the other part goes across the reverse and high clutch plates, to the reverse and high clutch drum, to the input shell, and to the sun gear. All the other gear train components are locked into the output shaft front planet gears and the reverse ring gear.

REVERSE

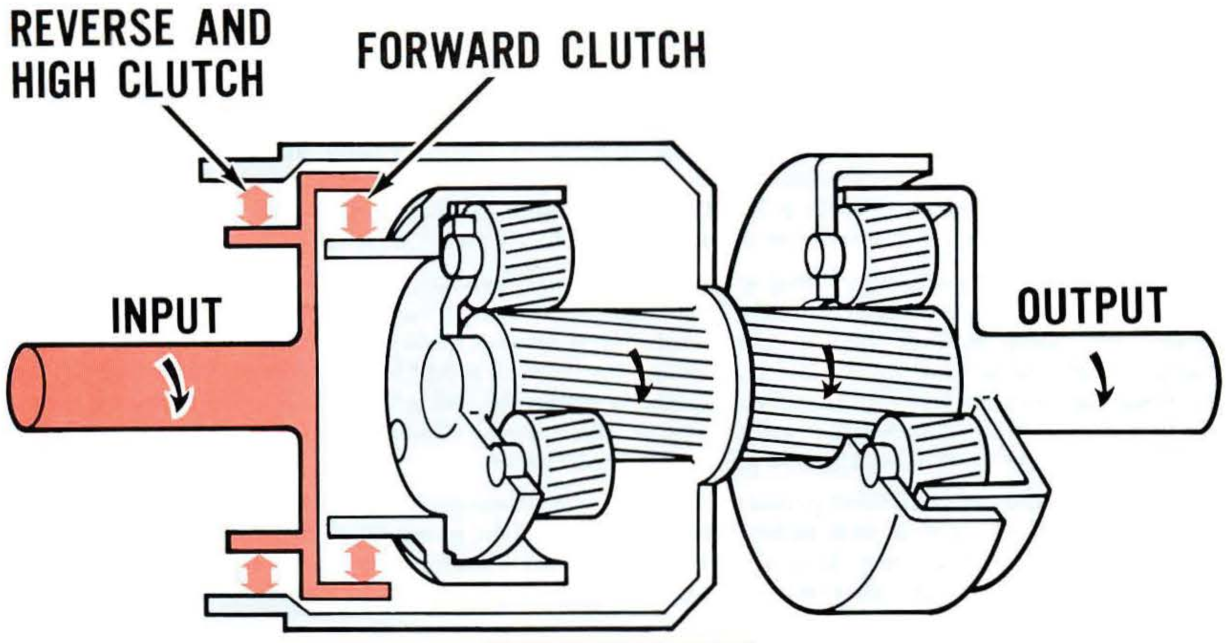
In reverse gear, the reverse and high clutch and the reverse and low band are applied.

Engine power flows through the torque converter to the transmission input shaft, to the forward clutch cylinder, across the reverse and high clutch plates, to the reverse and high clutch drum, to the input shell, and to the sun gear.

The sun gear rotates the reverse planet gears, which, in turn, rotate the reverse ring gear in a direction opposite to sun gear rotation. This reversal of rotation occurs, because the planet carrier is held stationary by the low and reverse drum. The drum is held by the applied low and reverse band.

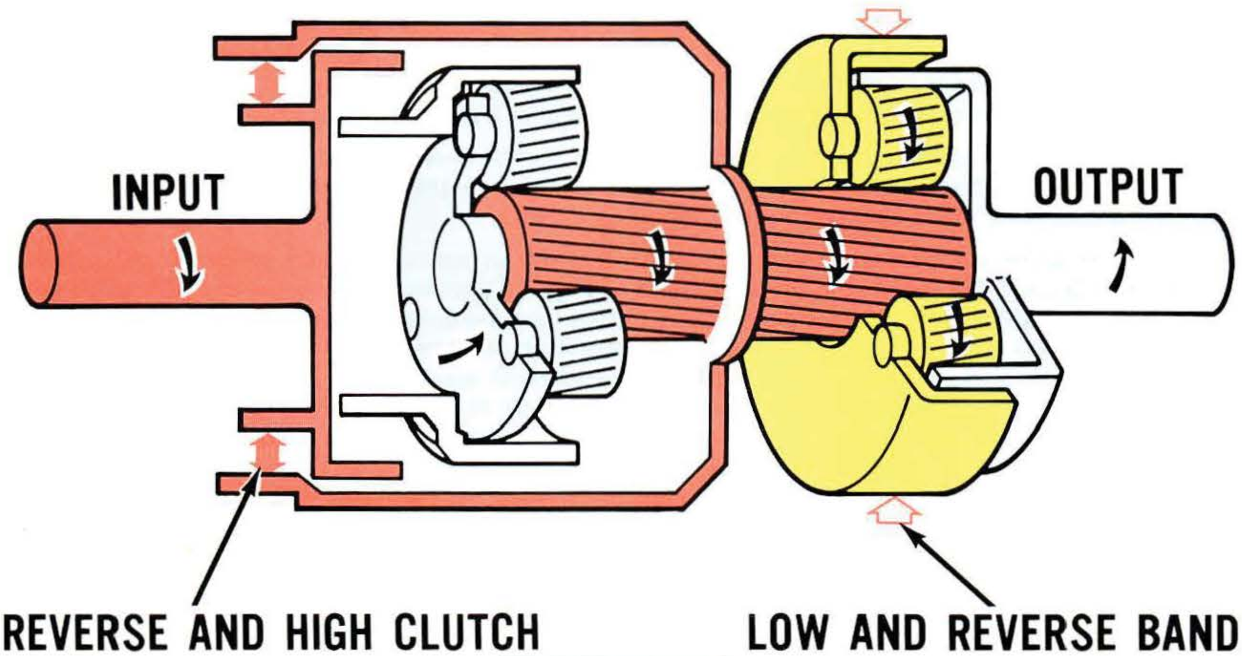
Output power flows begin at the reverse ring gear which is splined to the output shaft.

In reverse gear, the input to output ratio is 2.20:1.



HIGH GEAR

INPUT OUTPUT NOT WORKING HELD BY BAND



REVERSE

GEAR TRAIN POWER FLOW

CONTROL PRESSURE FLOW AND REGULATION

Transmission operation is affected by engine application, rear axle ratio, and elevation (reference to sea level). Throughout our discussion, we are dealing with a PEA-C Model transmission, coupled to a 289-2V engine, in a Ford car, with a 3.00:1 rear axle ratio. The car is operating at or near sea level, and the engine idles at 18 or more inches of intake manifold vacuum.

The transmission hydraulic control system comes into operation as soon as the engine starts to turn over. The front pump is coupled directly to the engine crankshaft through the torque converter and the flywheel. The pump is built to such close limits that it delivers oil to the control system, even at engine cranking speed. Oil flows from the pump, through the main case and into the control valve body. There are permanent (not controlled by valves) passages within the valve body, so that the pump oil can always flow to the control pressure regulator valve, the manual valve, the throttle valve, the governor secondary valve, the throttle boost valve and the 2-3 shift valve.

For convenience, let's call these permanent passages the main control pressure system. The pump can quickly fill this main control system because, at the start of the pump flow, only the throttle and secondary governor valves are open. At this point in our explanation, let's say merely that oil from the main control system flows through the throttle valve, fills the lines beyond it, and then the throttle valve closes.

The same may be said for the governor valves. Control pressure flows to the secondary governor valve. The secondary governor valve fills the passage to the primary valve, cuts off flow to the control valve body, and in effect, closes. The "in effect" expression refers to the fact that the flats on the governor secondary valve cause a constant flow through these flats whenever there is pressure at the secondary governor valve.

Up to this point, the regulator valve has been buttomed (up, in the diagram) in its bore, and held there by regulator springs. Pump oil from the main control system flows through three different passages to the regulator valve. The two lower passages which lead to the lower and center valley are not restricted. Pressure in these valleys does not cause valve movement, since the faces at the valley ends are equal in area. The third passage is restricted (0.040-inch orifice), and it leads to a face on the upper land. Pressure against this face area tends to move the regulator valve against its springs (down), since there is no opposite face area to cancel this pressure force. At a pressure of 55-61 psi, the regulator valve comes into balance (it starts to regulate). The pressure force (area x pressure), acting downward against the face of the valve, equals the spring forces acting upward against the valve.

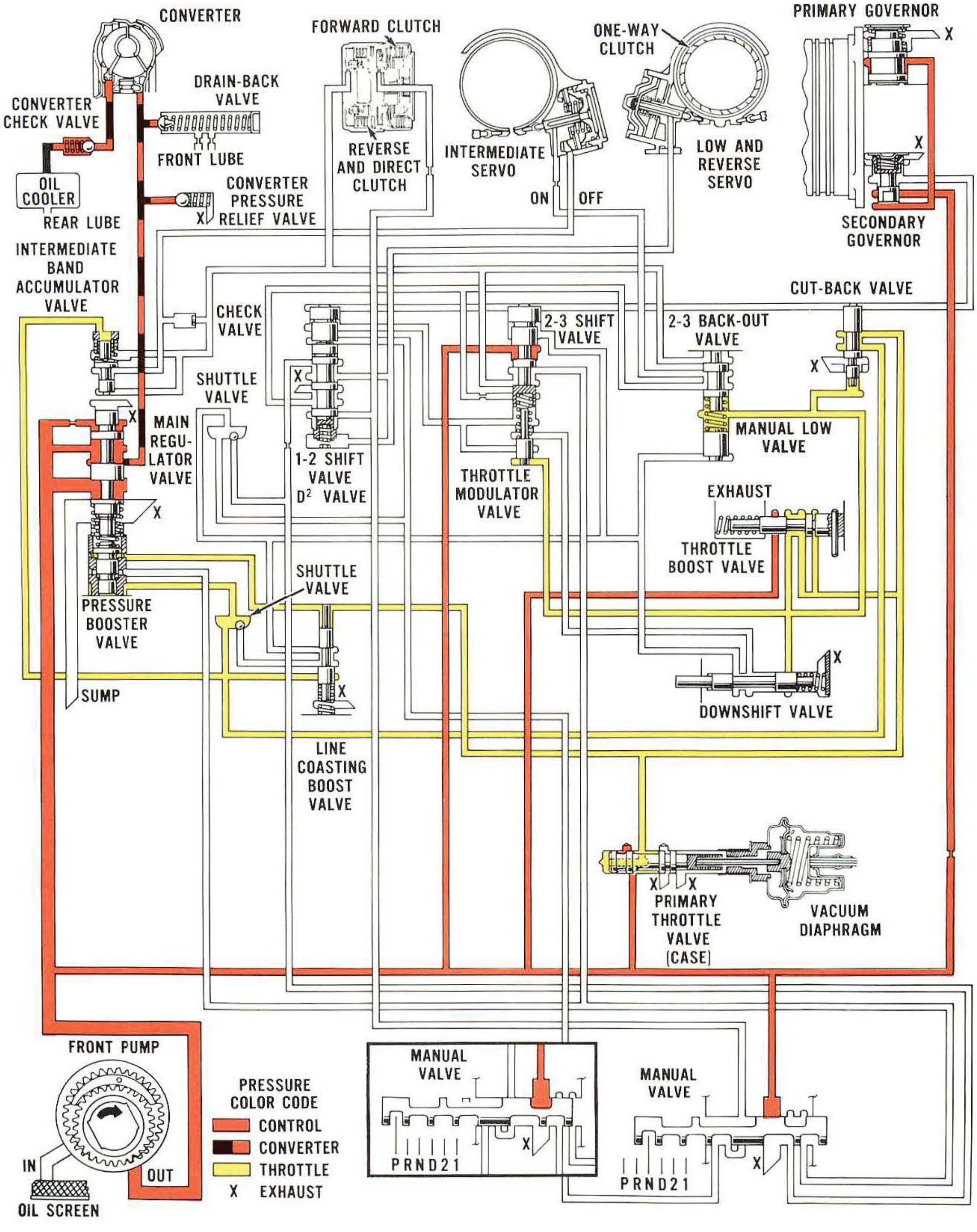
At an engine idle (and car standing still) condition, throttle pressure is about 10 psi. At this throttle pressure (10 psi), the throttle pressure system has no effect on the transmission's hydraulic control system. For our purposes, it is a charged but not operating circuit.

As volume increases, pressure will increase. An increase in control pressure (above 55-61 psi) will move the regulator valve down and the center land will open a port so that pressure can flow to the converter. This flow will reduce control pressure. A further increase in control pressure, after the converter has reached its maximum pressure, will cause the regulator valve to move down still more. This movement will cause the bottom land to open a passage between the main control system and the sump. The regulator valve is now dumping control pressure back to the sump, in order to hold control pressure down to 55-61 psi. Should control pressure drop below this value, the control pressure force will become less than the spring force, and the regulator valve will move up, cutting off control pressure flow to the sump. If this much movement does not restore control pressure, the regulator valve will move up farther and cut off control pressure flow to the converter.

Let's return to the throttle valve and see what happened there. The throttle valve movement is controlled by a spring-loaded diaphragm unit. The diaphragm unit spring is at about 12-1/2 pound compression at its normal working length. Like the regulator valve, the throttle valve is a balanced valve. The spring side of the diaphragm is vented to the engine intake manifold. The other side is vented to atmosphere through the transmission case. At manifold vacuum values (gauge readings) of more than 20 inches, the spring force at the diaphragm is less than the differential pressure (vacuum and atmospheric) force. As manifold vacuum falls below 20 inches, spring force becomes greater than the differential pressure force, and the spring exerts a force against the throttle valve through the pushrod.

The throttle valve admits control pressure to flow into its valley and flow through it to its left end. The throttle valve will balance the throttle pressure force acting at the left end of the valve against the diaphragm spring force coming through the pushrod. Throttle pressure will, therefore, be proportionate to manifold vacuum below 20 inches.

The operation of the governor valves start at speeds above 10 mph. It will be discussed on chart page 7500.1-6.

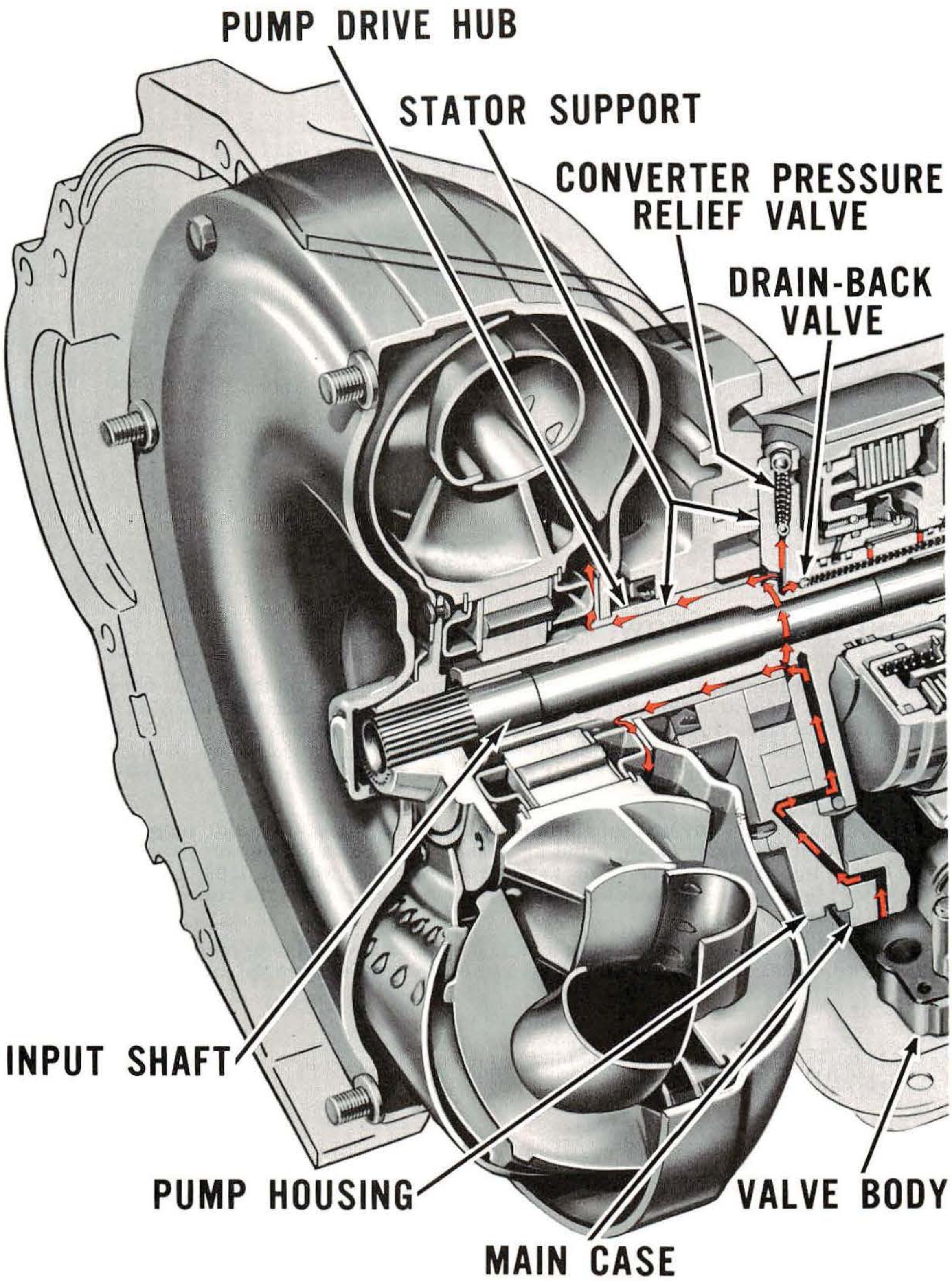


CONTROL PRESSURE FLOW AND REGULATION – ENGINE IS IDLING AND CAR IS STATIONARY

7500.1-6

CONVERTER-IN FLOW AND REGULATION

Oil flow to the converter starts when the regulator valve moves down, and the center land opens a passage that leads to the converter. As shown in the diagram, this flow is from the valve body to the main case, to the pump housing, to the stator support, and into the converter through a closed passage between the stator support and the converter pump drive hub. On its way into the converter, the oil worked against the converter relief valve and the drain-back valve. The relief valve opens at 70 psi. This means that converter-in pressure cannot exceed 70 psi. The drain-back valve opens at 5 psi to admit oil to flow into the front lubrication system. When the engine stops, the drain-back valve closes to prevent oil drainback from the converter. To prevent the lube system from taking too much oil from the converter-in flow, the lubrication flows are orificed. The drain-back valve is installed in the lubrication system to prevent the converter upper-half oil from draining back through the lubrication system to sump, when the engine is stopped.



CONVERTER IN

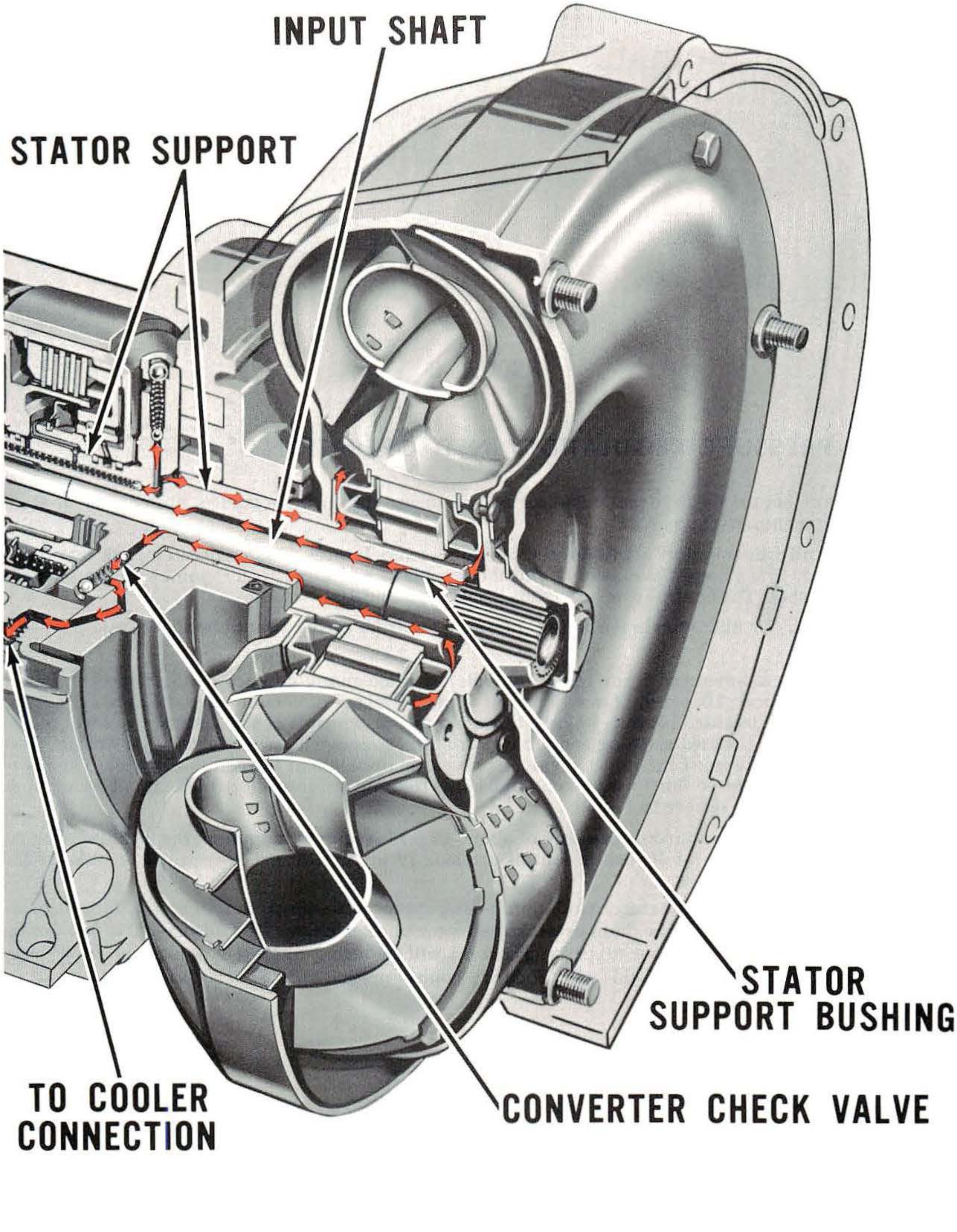
7500.1-7

CONVERTER-OUT FLOW AND REGULATION

In a normal transmission, there is an almost constant flow of oil through the converter, through the cooler, through the rear lubrication system, and back to sump, whenever the engine is operating. Occasionally the flow is interrupted; for example, during a shift into reverse at engine idle. Oil flow required to fill the reverse and high clutch and the reverse servo will cause a temporary drop in the main control system pressure. To restore main control pressure, the regulator valve cuts off converter feed until the clutch and servo are filled.

Oil flow out of the converter goes behind the front bushing in the stator support, through a closed passage between the stator support and input shaft, into the stator support flange, through the pump housing, and into the main case. Flow to and from the cooler, which is in the engine coolant radiator, is through steel tubing. All of the flow returning from the cooler enters the rear lubrication system before returning to sump.

The converter check valve does two things. It maintains a minimum pressure of 10 psi in the converter whenever the engine is operating; it keeps the converter full when the engine is stopped.



CONVERTER OUT

7500.1-8

CONTROL PRESSURE REGULATION IN D OPERATION

This diagram shows the hydraulic control system operation during a control pressure check at 10 inches of engine vacuum in D position.

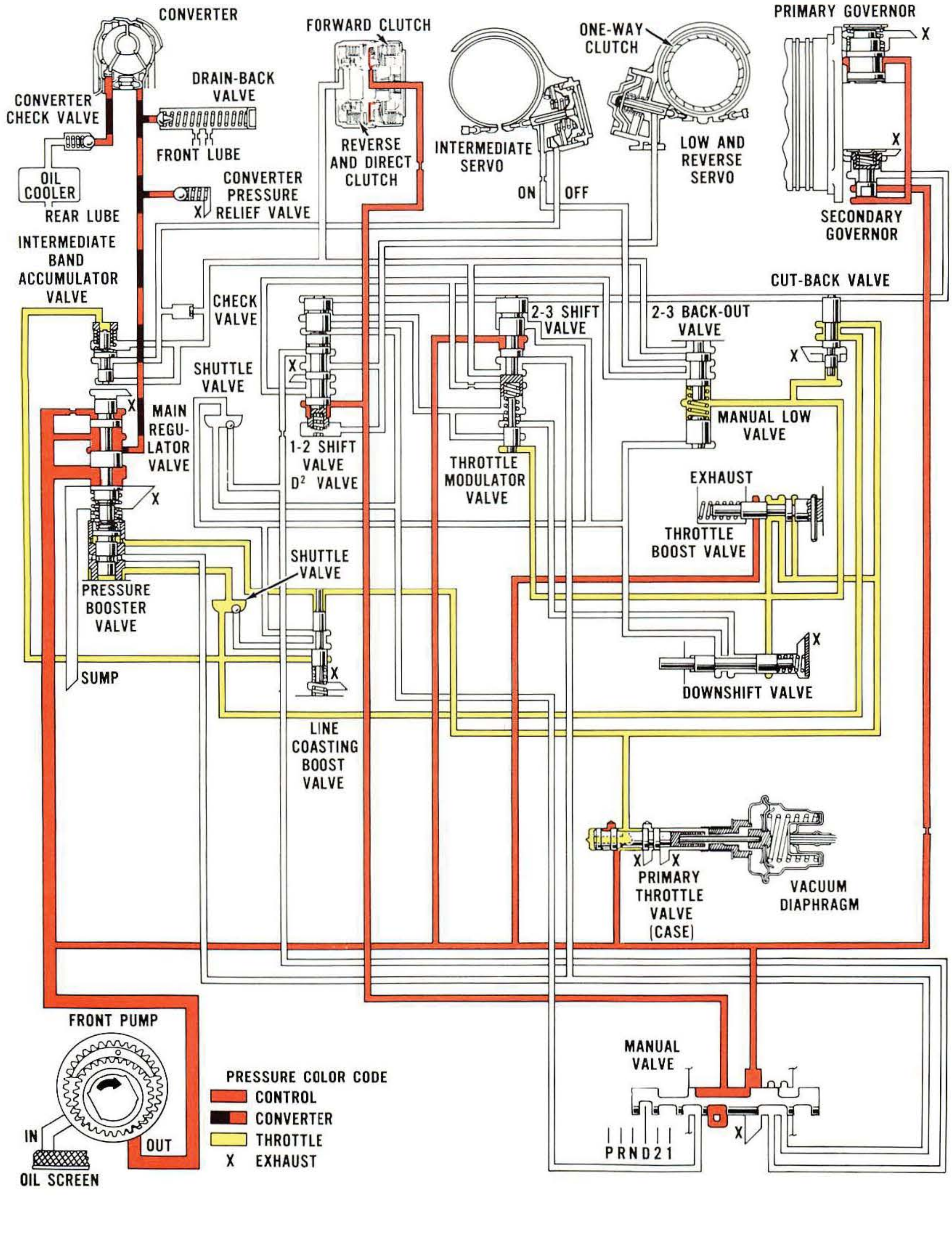
The engine and transmission are at normal operating temperatures. The service and parking brakes are firmly applied. The selector lever is in D and the throttle is advanced to the point that the vacuum gauge reads 10 inches. The control pressure reads between 93 and 104.

In this diagram, our interest is in the control pressure rise from 55-61 psi at idle to 93-104 psi at 10 inches.

As the throttle was advanced from 18 inches (idle) of intake manifold vacuum to 10 inches, throttle pressure rose from about 10 psi to about 40 psi. At about 17 inches of vacuum, throttle pressure rose to about 15 psi. At this pressure (above 10 psi), throttle pressure, which is acting against two faces on the pressure booster valve, exerted a strong enough upward force to move it upward against its spring. This upward movement compressed the booster valve spring and unbalanced the regulator valve. The regulator valve cut off or reduced the flows to sump and converter and retained more of the pump's output to raise control pressure and restore its balance.

At 10 inches of vacuum, a throttle pressure of about 40 psi is required to balance the throttle valve. At a primary throttle pressure of 40 psi, a control pressure of about 100 psi is required to balance the control pressure regulator valve.

Notice that in the control pressure regulation in D operation with the car standing still, throttle pressure is working at two places on the main pressure regulator booster valve. This means that at maximum throttle, a throttle pressure of about 80 psi (maximum) will be acting against two faces of the booster valve. At wide-open throttle at stall, this will produce a control pressure of 137-150 psi.



CONTROL PRESSURE REGULATION IN D OPERATION

CONTROL PRESSURE REGULATION IN 1 (AND 2) OPERATION

Both the engine and the rear wheels can produce a high transmission input torque. Even though the torque input may come in through the output shaft, it is still a torque input, as far as the transmission clutches and bands are concerned.

On the previous chart, we saw how throttle pressure adjusts control pressure to engine input torque. On this chart, we will see how the manual valve adjusts control pressure to rear wheel input torque.

On some C4 models, the transmission will downshift to first gear, from high or second, at speeds as high as 40 mph, when the selector lever is moved into 1. Should this shift occur at closed throttle with only a throttle pressure boost arrangement in the control system, the shift would occur at minimum control pressure (about 50 psi).

In the current C4 transmission, a newly designed line coasting boost valve will automatically raise control pressure for manual 3-1, 3-2, and 2-1 shifts at closed throttle at all road speeds.

In this diagram, first gear 1 is shown as a starting gear. Our interest here is to show control pressure regulation in 1 operation, versus control pressure regulation in D operation.

When the manual valve is shifted to 1, control pressure flows to the forward clutch and the lower valley of the D2 valve. It flows to and through the D2 valve to the low and reverse servo and to the ball shuttle valve (upper). From the ball shuttle valve, control pressure flows to three places.

Let's take the three flows from the shuttle valve in their order of complexity.

From the shuttle valve, the least complicated control pressure flow is to the lower face of the 2-3 shift valve top land and to the manual low valve.

From the shuttle valve, the second most complicated control pressure flow is to the downshift valve. The downshift valve is a limiting valve. It is assembled under spring compression and it has a face area differential in its valley. At about 120-psi pressure in the valley, pressure force and spring force are equal.

From the shuttle valve, the most complicated flow and its regulation thereafter, is to the line coasting boost valve. The line coasting boost valve is assembled under a 4-1/4 pound spring compression. In its rest position, it is wide open. This means that control pressure flow to the line coasting boost valve in 1 and 2 flows through the valve to the main regulator booster valve. In D, there is no control pressure flow to the coasting boost valve.

The line coasting boost valve is a limiting valve. It has an upper and lower valley face area differential. The lower valley face is larger in area than the upper valley face. When pressure is present in the valley, a downward force is produced in the valley (and on the valve). When pressure in the valley is about 80 psi, the pressure force on the valve balances the spring force on the valve. At a coasting boost pressure of 80 psi (and with no throttle pressure at the top), the line coasting boost valve is in balance. It is limiting coasting boost pressure to a maximum of 80 psi.

With a line coasting boost valve pressure of 80 psi (and no throttle pressure) working at the main pressure booster valve, control pressure will be regulated to about 110 psi. This occurs only at engine idle with the car stationary or at engine idle with the car coasting.

In addition to line boost and spring force, throttle pressure force also works at the top of the line coasting boost valve.

Remember, that the line coasting boost valve is installed under a 4-1/4 pound spring force. Coasting boost pressure works on a valley differential area (0.052 square inches) in opposition to spring force. Throttle pressure, at the top of the line pressure coasting boost valve, works on an "equal" area (0.049 square inches) in opposition to spring force.

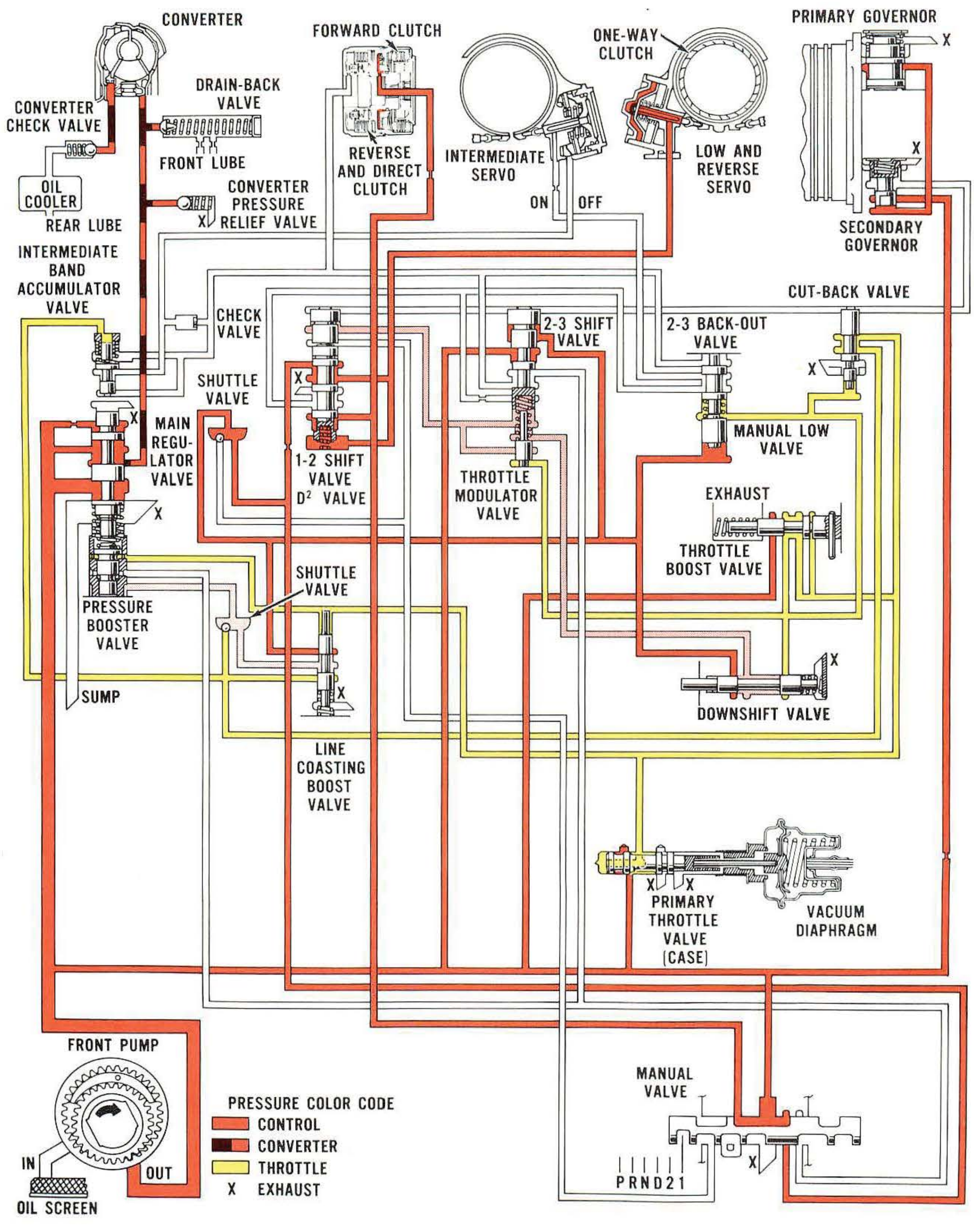
All of this means that throttle pressure and coasting boost pressure can work together or separately, and that they must produce a force (pressure times area) of 4-1/4 pounds to balance the line coasting boost valve. This coming-into-balance means that line coasting boost pressure does not exceed 80 psi, nor does it fall below 80 psi, should the transmission be shifted into 1 (or 2) with zero throttle pressure.

At 10 inches of intake manifold vacuum, throttle pressure will be about 40 psi and will be equal to line coasting boost valve pressure. This means that at vacuum values below 10 inches, throttle pressure before cutback in 1 (and 2), will be higher than coasting boost pressure, and the shuttle valve will direct throttle pressure, rather than line coasting boost pressure, to the booster valve.

On the transmission control pressure gauge, with a normal transmission, gauge readings will be as follows:

1. At engine idle and car stationary in D, the gauge will read 55-61.
2. At 10 inches of vacuum and car stationary in D, the gauge will read 93-104.
3. At stall in D, the gauge will read 137-150.
4. At engine idle and car stationary in 1 (and 2), the gauge will read 55-113. Attaining the higher limit at idle will depend on the individual pump capacity, oil temperature, etc. The higher control pressure in 1 and 2 comes from the line coasting boost pressure flow to the main booster valve.
5. At 10 inches of vacuum and car stationary in 1 (and 2), the gauge will read 93-104. As the throttle is advanced from idle (above 18 inches) to 10 inches in 1 (and 2), the gauge readings will usually drop slightly. This is caused by the increase in throttle pressure decreasing the line coasting boost pressure.
6. At stall in 1 (and 2), the gauge will read 137-150.

See chart page 7501.1-17 for the control pressure curves versus manifold vacuum in D and 1 (and 2) operations.



CONTROL PRESSURE REGULATION IN 1 (AND 2) OPERATION

GOVERNOR OPERATION

Governor pressure is produced and controlled by two governor valves. Both valves rotate with the transmission output shaft at output shaft speed.

The top view on the facing page shows the governor valves in their rest positions. Rest positions refer to the valves' positions with the engine stopped and the car stationary. Under these conditions, the valves are positioned as shown. The secondary governor valve (lower valve in the view) is held in its extreme outward position by a spring. This spring is installed between the secondary governor valve's inner (large) end and a spring retainer, which is inserted into slots in the one-piece governor valve housing. At assembly, this spring is installed under compression. The primary governor valve is also positioned by a spring while it is in its rest position. This spring is installed between the primary governor valve outer end and a washer. The washer is retained in the governor housing by a Tru-Arc snap ring. This primary governor valve spring is also assembled under compression.

Once more, when the engine is not operating and the car is not moving:

1. The secondary governor valve is held in its extreme outward position by its spring. Remember, this spring was installed under compression. It will be in this outward position even if it happens to be at the top, because the spring force acting on the valve is greater than the gravitational force acting on the valve.

2. The primary governor valve is held in its extreme inward position by its spring. Since this spring was also installed under compression, the up or down stopping point of the valve will not change its position.

The center view shows what happens at the governor valves with the engine operating and the car standing still, or the engine operating and the car moving forward at speeds of less than 10 mph.

With the engine operating, control pressure flows to the governor valves. As control pressure flows to the governor valves, it first flows to the secondary governor valve. At the beginning of control pressure flow to the governor, the secondary governor valve is outward or wide open, as shown in the top view (facing page). When control pressure starts through the wide-open secondary governor valve, it immediately produces a governor pressure. This happens, because the upper face on the secondary governor valve valley is larger in area than the valley's lower face. This difference in face areas will produce an "up" force on the valve. When the control-pressure-produced "up" force on the valve is greater than the installed spring force, the valve will move up to cut off control pressure flow. When the secondary governor valve moves up, two flats on the valve's outer (lower) land permit control pressure to flow past the outer land and into the circuit (passage) between the secondary and primary governor valves. Since the primary governor valve is in its extreme inward position, flow into this circuit is "dead-ended." This means that the pressure in this passage and under the other end (face) of the secondary valve will build up to the same value as control pressure, because the passage is a "dead-end."

Full control pressure under the outer end of the secondary governor valve will cause the secondary governor valve to move to its maximum inward position. At its maximum inward position, the secondary governor valve opens an exhaust in the governor pressure passage to the control valve body.

In the lower view, governor operation is shown with the engine operating and the car moving forward above 10 mph. The term "engine operating" is used in this discussion, because the transmission does not have a rear pump. This means that if the engine is not turning over, the transmission does not have a pump running to produce control pressure.

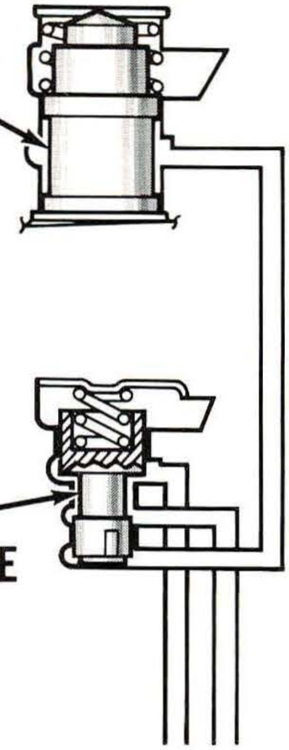
At about 10 mph, the primary governor valve opens, and it will stay open as long as road speed is greater than 10 mph. The primary governor valve opened, because centrifugal force acting on the valve became greater at 10 mph than the installed "hold close" spring force acting on the valve.

When the primary governor valve opened (moved outward), the pressure in the secondary to primary governor valves circuit was exhausted. With the pressure under the outer end of the secondary valve exhausted, the secondary valve became a truly balanced valve. The secondary governor valve is now balanced between governor pressure force acting up, and spring plus centrifugal force acting down. The governor pressure force comes from control pressure flow into the secondary governor valve valley. Since the upper valley face is larger in area than the lower valley face, any pressure in the valley produces an inward (up) force. Opposing the inward force are the installed spring force and centrifugal force. Centrifugal force is proportionate to the speed of governor rotation (car road speed).

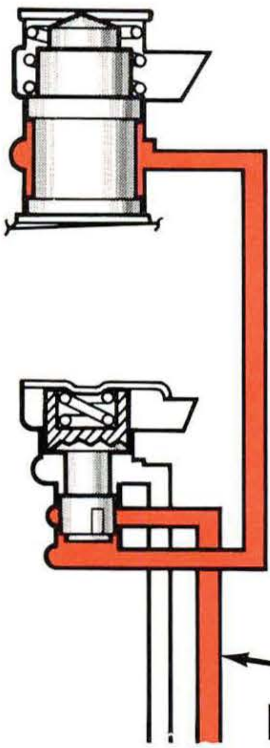
At car speeds above 10 mph, therefore, a governor pressure proportionate to road speed is produced by the secondary governor valve. As car speed falls below 10 mph, the primary governor valve will close, and the governor operation will return to that shown in the center view.

PRIMARY GOVERNOR VALVE

GOVERNOR VALVES IN REST POSITION



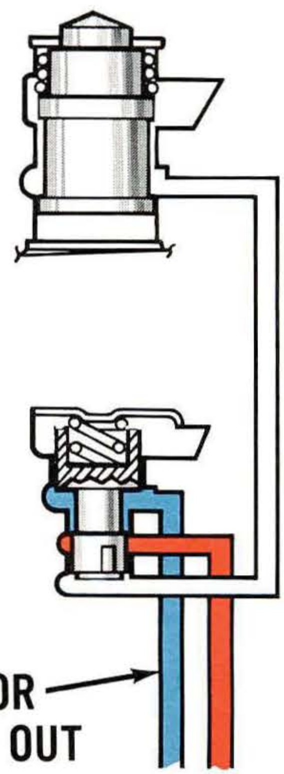
SECONDARY GOVERNOR VALVE



GOVERNOR IN OPERATION— ENGINE OPERATING AND CAR SPEED BELOW 10 MPH

CONTROL PRESSURE IN

GOVERNOR IN OPERATION— ENGINE OPERATING AND CAR SPEED ABOVE 10 MPH



GOVERNOR PRESSURE OUT

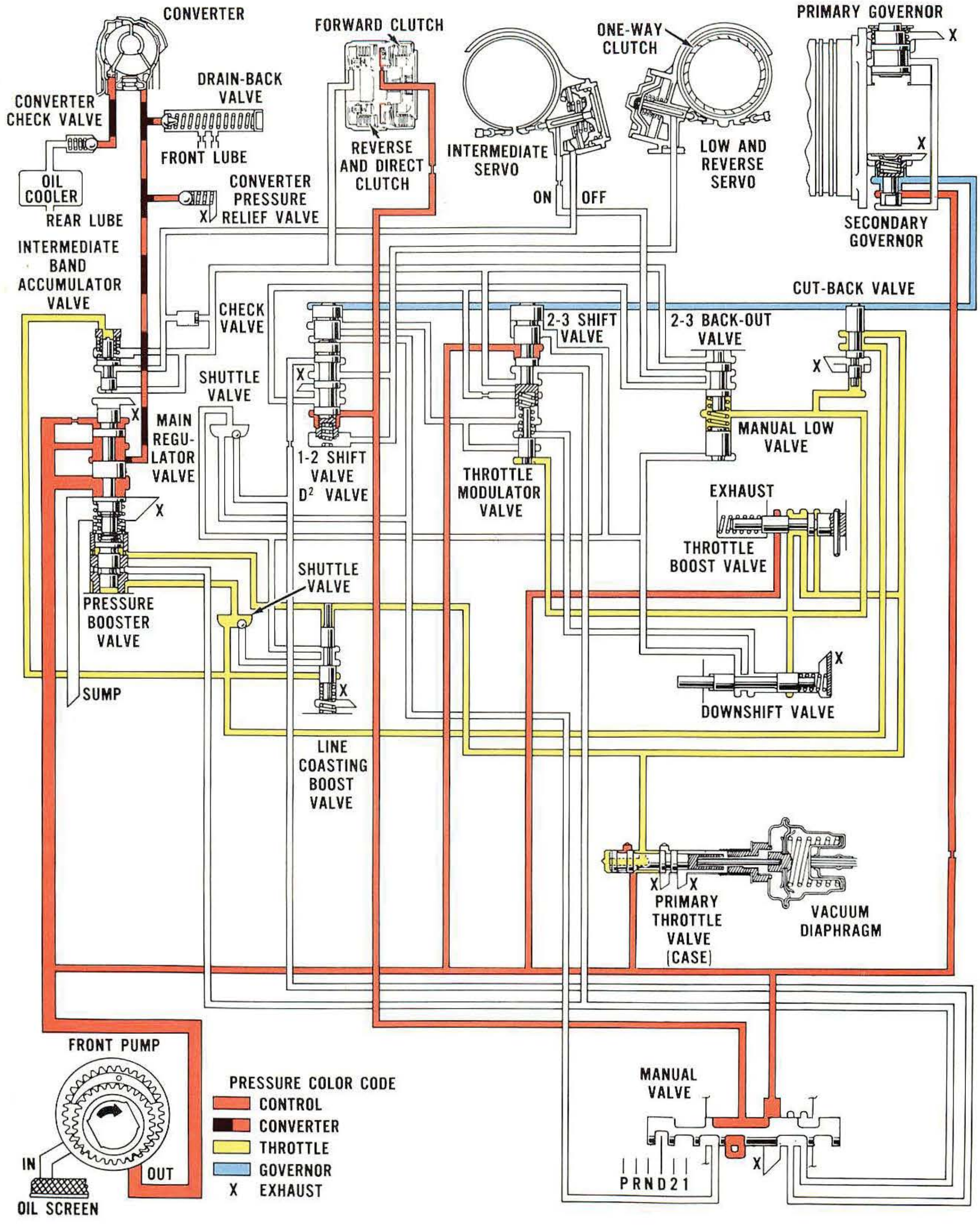
FIRST GEAR D

When the manual valve is moved from P or N to D, only one port is opened for control pressure flow by the manual valve. From this port, control pressure supplies the D2 valve for the 1-2 upshift and it also applies the forward clutch.

In this diagram, the driver has depressed the accelerator to give a manifold vacuum of 10 inches. Throttle pressure is about 40 psi and control pressure is about 95 psi.

Throttle pressure is not high enough to open the throttle modulator valve. This valve opens at about 45 psi. Although there is no modulated throttle pressure under the shift valves, they are sensitive to throttle opening. Control pressure is working in both shift valve valleys and both valleys have a face area differential, which produces an up force.

The road speed is above 10 mph and governor pressure is present in the control valve body. Governor pressure is not yet high enough to force the cut-back valve down.



FIRST GEAR D – BEFORE CUTBACK – VACUUM 10 INCHES

SECOND GEAR D

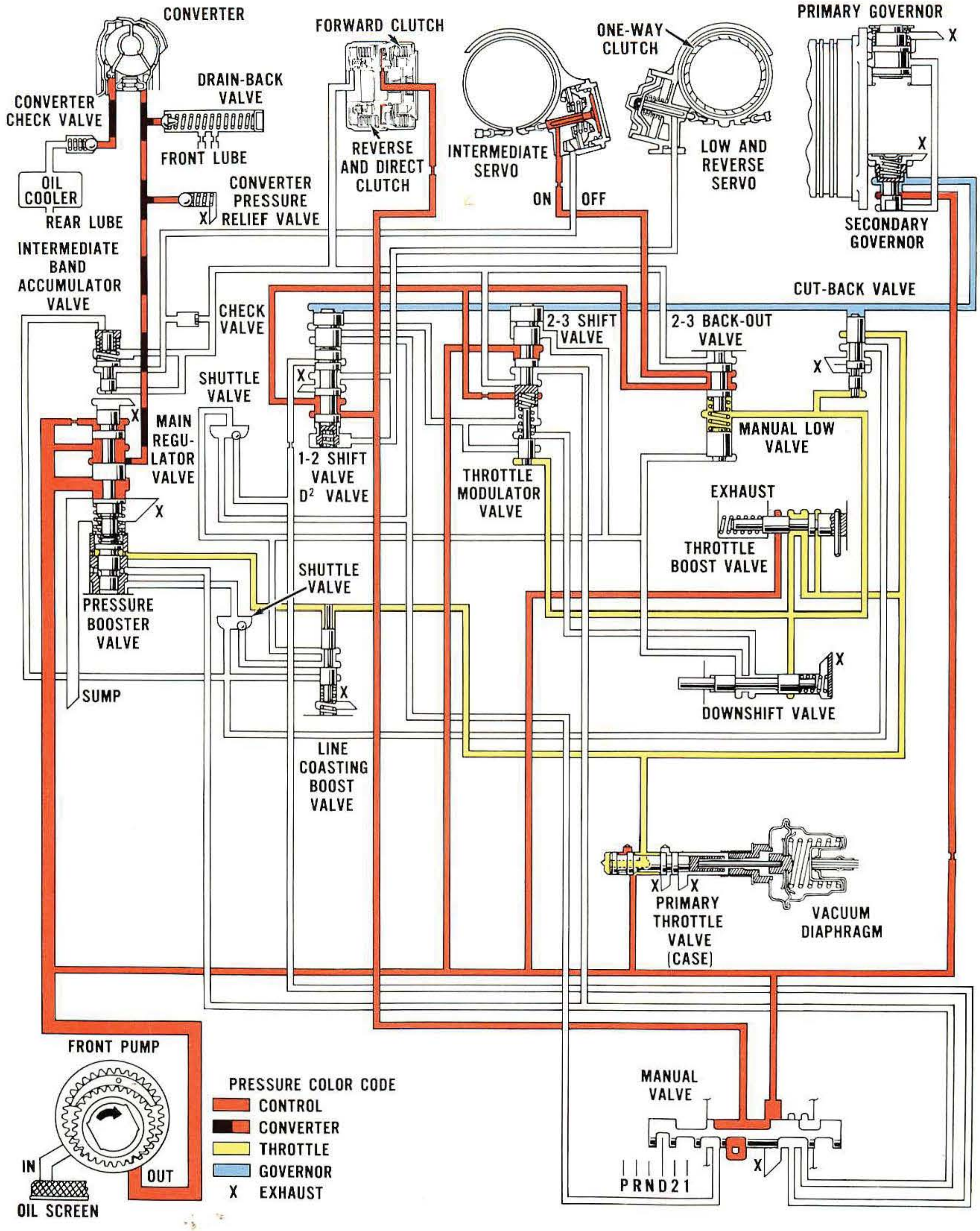
The 1 - 2 shift occurred when governor pressure force, acting downward on the 1 - 2 valve, overcame the spring and control pressure forces acting upward. When the 1 - 2 and D2 valves moved down, control pressure flowed to the 2 - 3 backout valve, then to the intermediate servo apply line.

As the servo piston moves to apply the intermediate band, it forces the fluid on the release side of the piston out of the servo. This release fluid has to lift the intermediate band accumulator valve against its spring, and at times throttle pressure, before it can return to sump through the 2 - 3 shift valve and the manual valve.

This valve is also sensitive to the reverse and high clutch pressure and will be discussed again on the 3 - 2 kickdown chart.

In this situation, the cut - back valve has been forced down by governor pressure against throttle pressure. This means that the road speed at which cut - back occurs will vary with throttle opening (page 13).

After the cut - back valve comes down in D operation, throttle pressure can work at only one place on the booster valve. At stall or before cut-back, control pressure could go as high as 150 psi. After cut-back, maximum control pressure in D, 2 and 1 is about 110 psi. This difference in control pressure, before and after cut - back, is caused by the two places and then the one place at which throttle pressure can work at the main regulator booster valve.

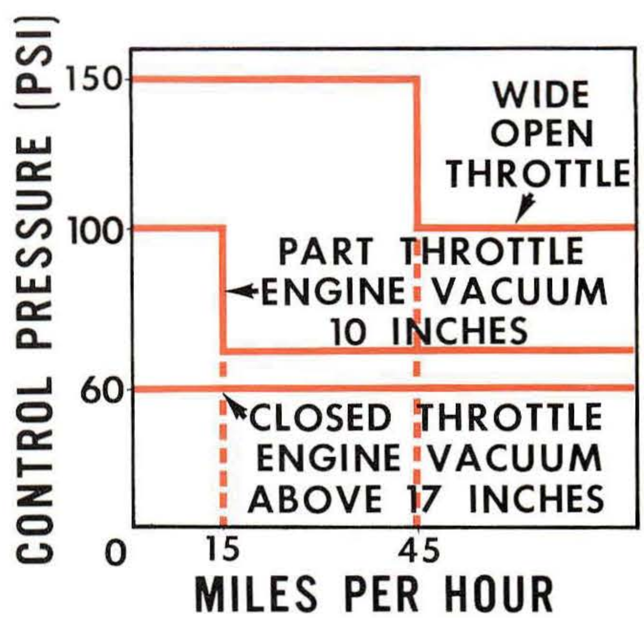


SECOND GEAR D – AFTER CUTBACK – VACUUM 10 INCHES

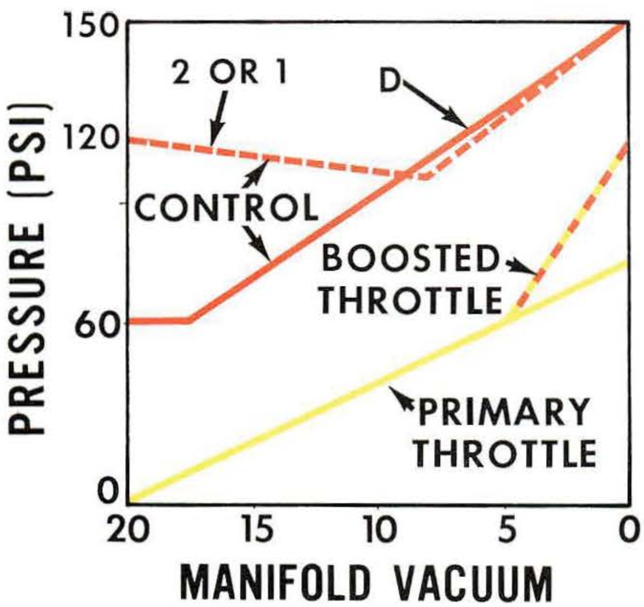
7500.1-13

This page is provided to give you a graphic illustration of certain transmission pressures. The "whys and wherefores" have been covered on the preceding pages.

CONTROL PRESSURE VARIATIONS WITH THROTTLE OPENING AND ROAD SPEED

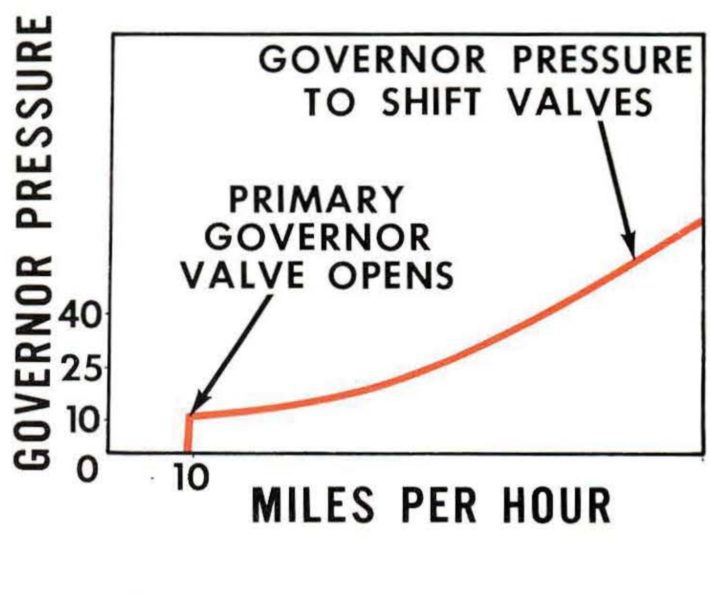


RANGE



THROTTLE PRESSURE AND CONTROL PRESSURE VARIATIONS

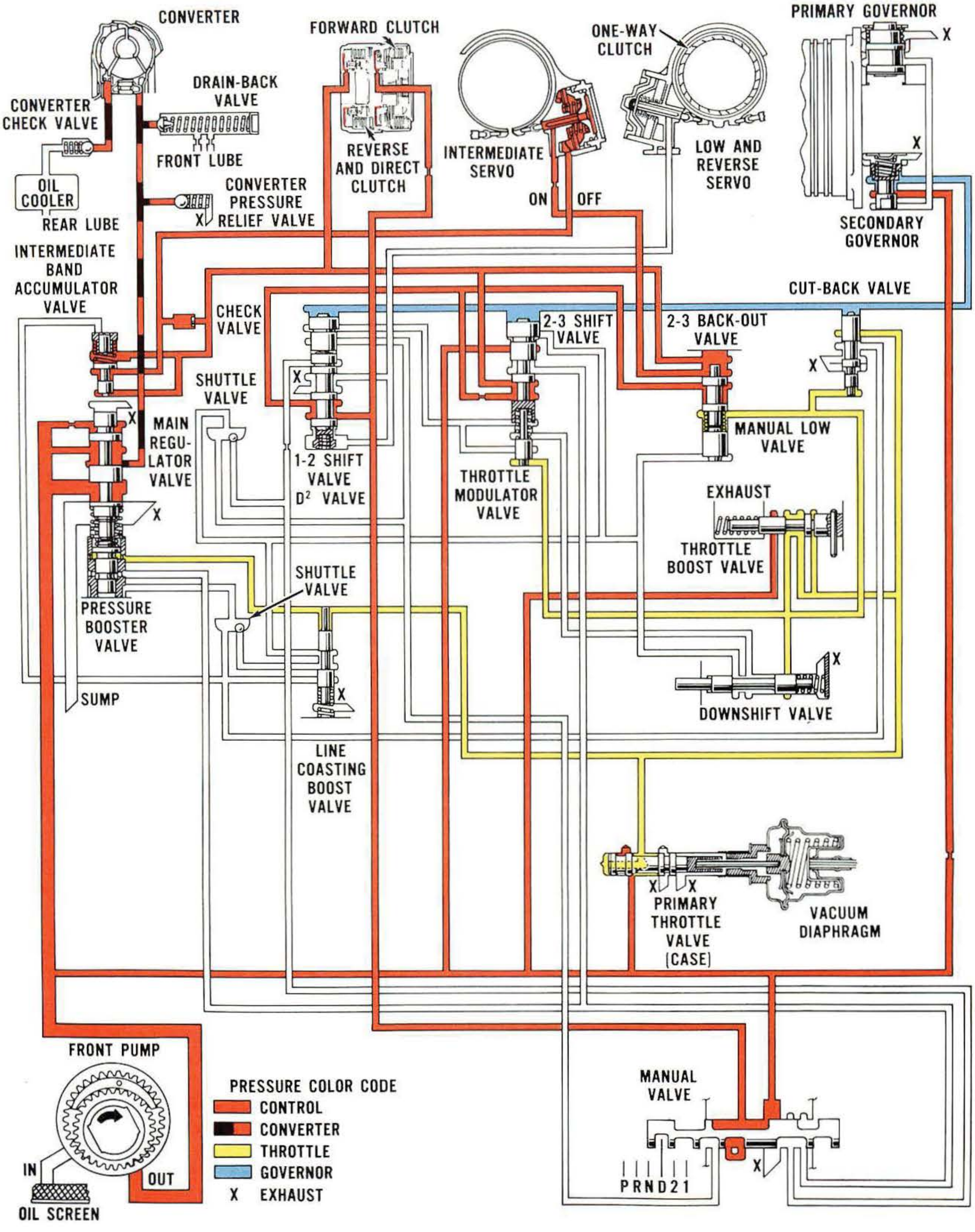
GOVERNOR PRESSURE VARIATION WITH ROAD SPEED



HIGH GEAR

To get the transmission from intermediate (second) gear to high, the intermediate band must be released, and the reverse and high clutch must be applied. When the governor pressure force, acting down at the 2-3 valve, becomes stronger than the combined spring and control pressure forces acting upward at the other end, the 2-3 valve is forced down.

Control pressure can now flow through the 2-3 valve, to the release side of the intermediate servo, and to the reverse and high clutch. Control pressure flow from the 2-3 valve to the release side of the intermediate servo is not affected by the accumulator valve, since flow in this direction will open the servo check valve. With the intermediate band released and both clutches applied, the transmission is in high gear.



HIGH GEAR D – MODERATE THROTTLE

3-2 KICKDOWN

At maximum throttle (through detent), 2-3 upshift can come in at a road speed as high as 78 mph. At maximum throttle (through detent), downshift (kickdown) can come in at a road speed as high as 72 mph. This spread in upshift and downshift speed is caused by a control pressure force acting in the 2-3 shift valve upper valley.

When the 2-3 shift valve is in its rest position, control pressure flows into the upper valley of the valve. The face at the top of the valley is larger in area than the face at the bottom of the valley. This difference in face areas produces an up force on the 2-3 shift valve.

When the 2-3 shift valve moves down, flow to this upper valley is cut off and the pressure in the valley is exhausted at the manual valve.

The forces acting, therefore, during a through-detent upshift and downshift are not the same. The difference is the control pressure force in the 2-3 valve upper valley. This force is added and taken away to prevent 2-3 shift valve hunt with small changes in road speed and throttle opening.

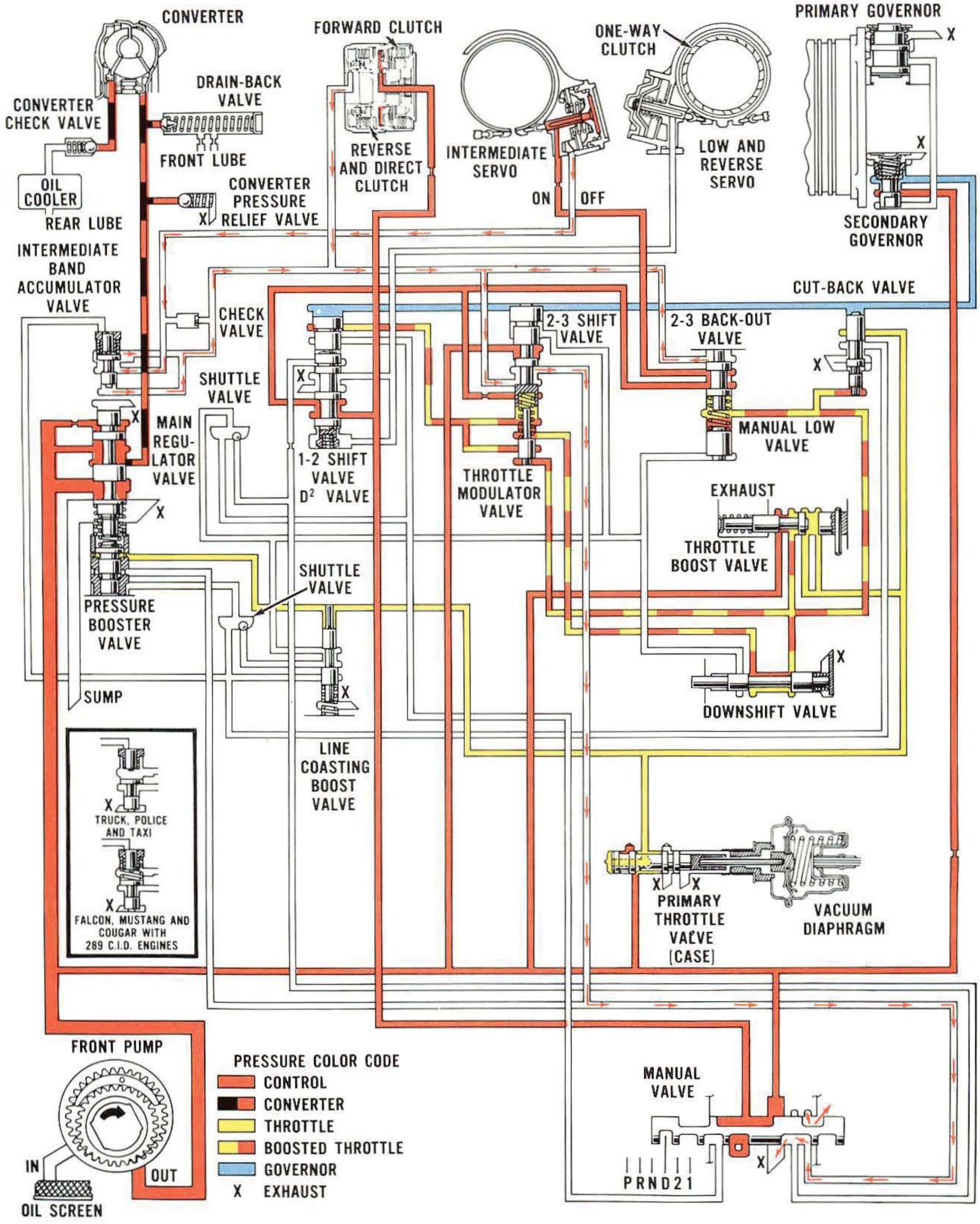
When the driver depresses the accelerator pedal through detent, the downshift valve is forced open (to the right) against its spring. This permits boosted throttle pressure to flow to the 2-3 shift valve and work against its lower face. At road speeds as high as 64-76 mph, this control pressure force is greater than governor pressure force and the 2-3 valve is forced up. When the valve goes up, the reverse and high clutch apply and intermediate servo release pressure is exhausted. The intermediate servo apply pressure, which has been in the servo during high-gear operation, can now apply the intermediate band and the transmission is now in intermediate gear.

Band application is controlled by the intermediate band accumulator valve. In the main diagram, this valve is sensitive to the pressure in the reverse and high clutch. The insert shows other valve bodies in which, the accumulator valve is not sensitive to reverse and high clutch pressure.

Notice that in the truck, police and taxi valve bodies, the accumulator valve spring is eliminated.

On a coastdown in D, the transmission will downshift from high to first (3-1).

At closed throttle, throttle pressure is about 10 psi. This means that only the springs and control pressure are acting to move the 1-2 and 2-3 shift valves up. The spring and control pressure forces are not strong enough to move the valves against governor pressure. At 10 mph, the primary governor valve closes. The secondary governor valve now is forced up and it exhausts governor pressure from the control valve body. At this point, both the 1-2 shift and the D2 valve and the 2-3 shift valve move up. The D2 valve exhausts intermediate servo apply pressure. The 2-3 valve exhausts reverse and high clutch apply pressure and intermediate servo release pressure. Only the forward clutch is now applied, and the car is freewheeling, if drive shaft speed is higher than engine crankshaft speed. If the engine speed is increased so that it is greater than drive shaft speed, the one-way clutch applies and the transmission is in first gear D.



3-2 KICKDOWN AT 55 MPH

2-3 BACK-OUT VALVE

In intermediate gear, the forward clutch and the intermediate band are applied. In the transmission gear train, the front ring gear is driving, the load is on the planet carrier, and the sun gear is stationary. There is a reaction force working at the sun gear trying to turn it counterclockwise (from the front).

To get the transmission into high gear, the sun gear will have to start turning clockwise and come up to the same speed as the ring gear. To get the sun gear turning, the reverse and high clutch applies and starts to drive the sun gear through its drum and the input shell. At the start of the shift, the drum, the shell, and the sun gear are being held stationary by the intermediate band. A smooth shift requires, therefore, that the band release be timed precisely with the clutch application. If the band releases before the clutch applies, the sun gear will be driven in a counterclockwise (from the front) direction and the transmission will be in neutral. This is often referred to as a "buzz-up" during upshift. This "buzz-up" describes the sudden increase in engine crankshaft speed, which results from a suddenly unloaded engine.

If the clutch applies before the band releases, the transmission will be "locked" into two gears at the same time. The clutch and band are now "fighting" each other. The clutch is trying to start the drum rotating and the band is trying to hold it stationary. This condition is often called "lock-up" or "tie-up" during the upshift. It causes a harsh shift.

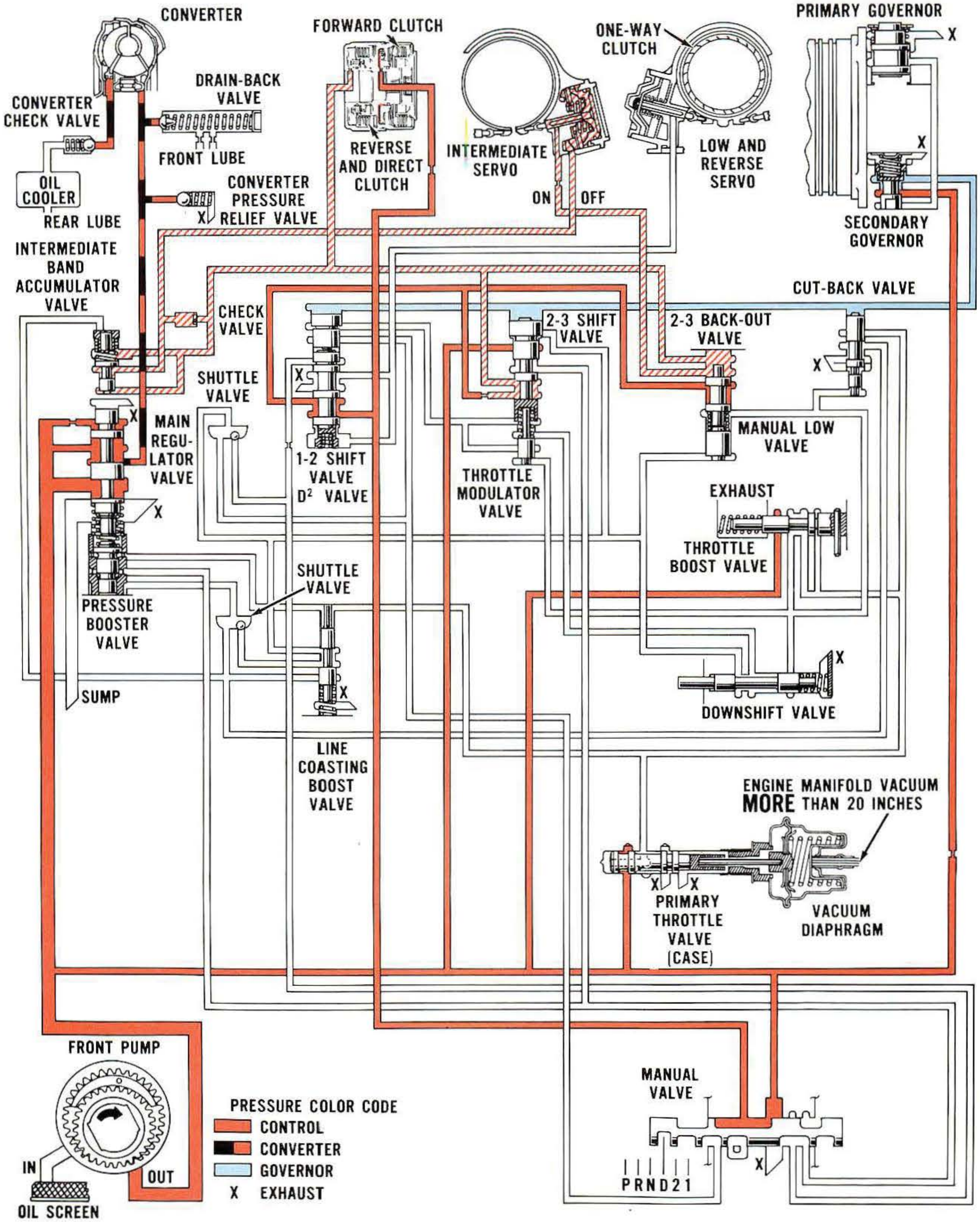
Let's get back to our hydraulic control system. When the 2-3 shift valve moves down, control pressure flows through an orifice, to and through the 2-3 valve, to the release side of the intermediate servo, and to the reverse and high clutch.

The rate of pressure build-up in the servo release and clutch apply line will vary with throttle opening and road speed, because control pressure varies with throttle pressure and road speed.

The orifice and adjusted control pressure cause a servo release and clutch apply pressure build-up rate, which provides smooth upshifts at steady throttle. At steady throttle, engine power is flowing through the transmission and the shift is a "power-on" shift.

Should the driver release the throttle after the 2-3 shift has started, but before it has been completed, the shift could be harsh. With this sudden reduction in engine torque flow, there might be enough pressure in the servo release and clutch apply line to engage the clutch, but not enough pressure to release the servo. Here we could have a clutch and band "fight." To prevent this condition, the 2-3 back-out valve comes into operation.

With zero primary throttle pressure, a servo release and clutch apply pressure of about 9 psi will push the 2-3 back-out valve down. As the 2-3 back-out valve comes down, it does two things. First, it cuts off control pressure flow to the apply side of the servo. Second, it opens a passage so that the apply pressure, which is trapped between the back-out valve and the servo piston, can now mix with the incoming servo release and clutch apply pressure. This causes servo apply and release pressures to become equal, and now the servo return spring can move the servo piston and release the band.

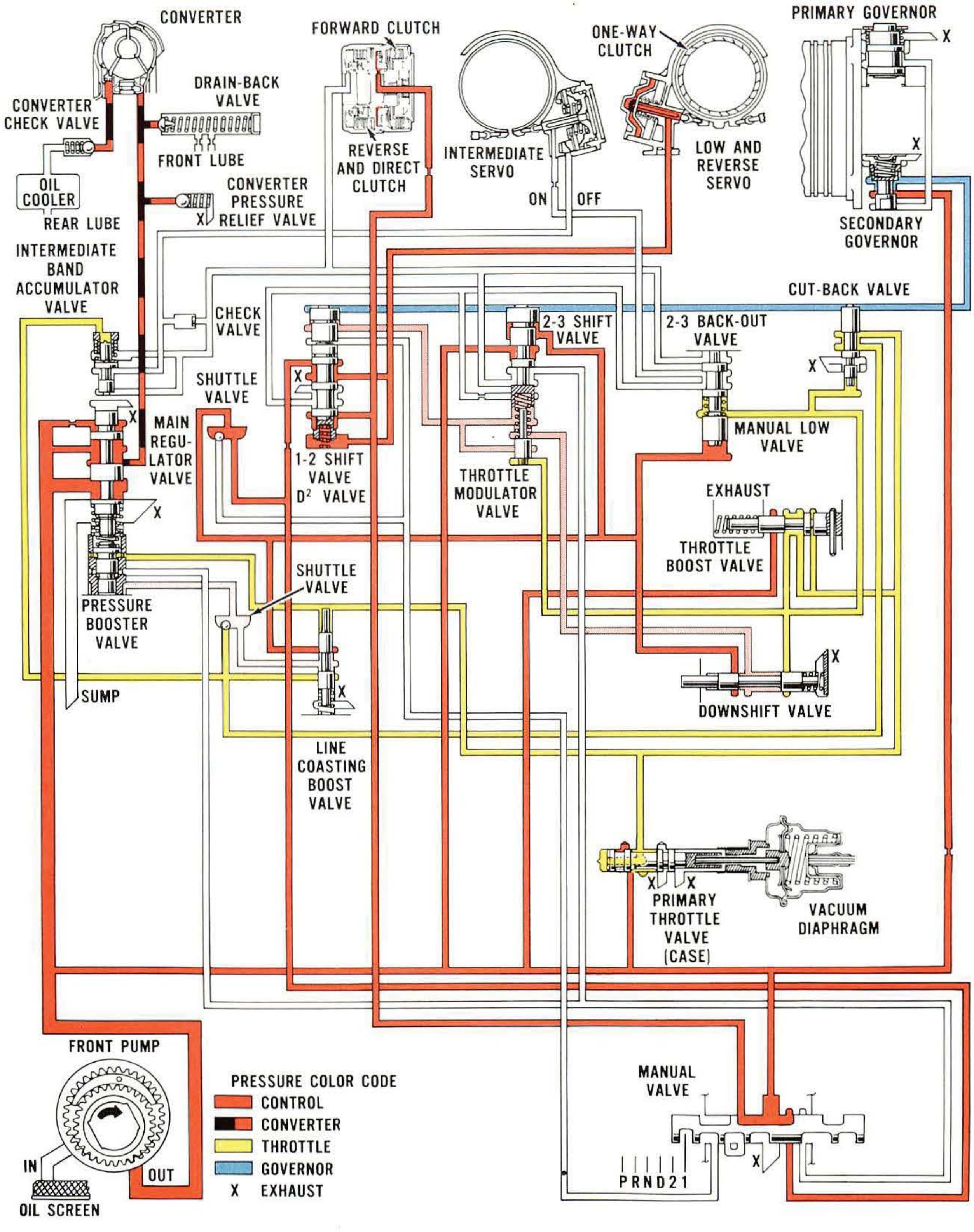


2-3 BACKOUT SHIFT AT 55 MPH

FIRST GEAR 1

This is the same diagram as chart page 7500.1 - 9 except for governor pressure. On chart page 7500.1 - 9, our interest was control pressure regulation in 1 (and 2) with the car standing still. Now we can turn our attention to control pressure regulation with governor pressure in the control valve body.

At stall and before cutback on the road, maximum control pressure can go as high as 150 psi. Again, this maximum control pressure is produced by maximum (about 80 psi) throttle pressure working at two places on the main booster valve.



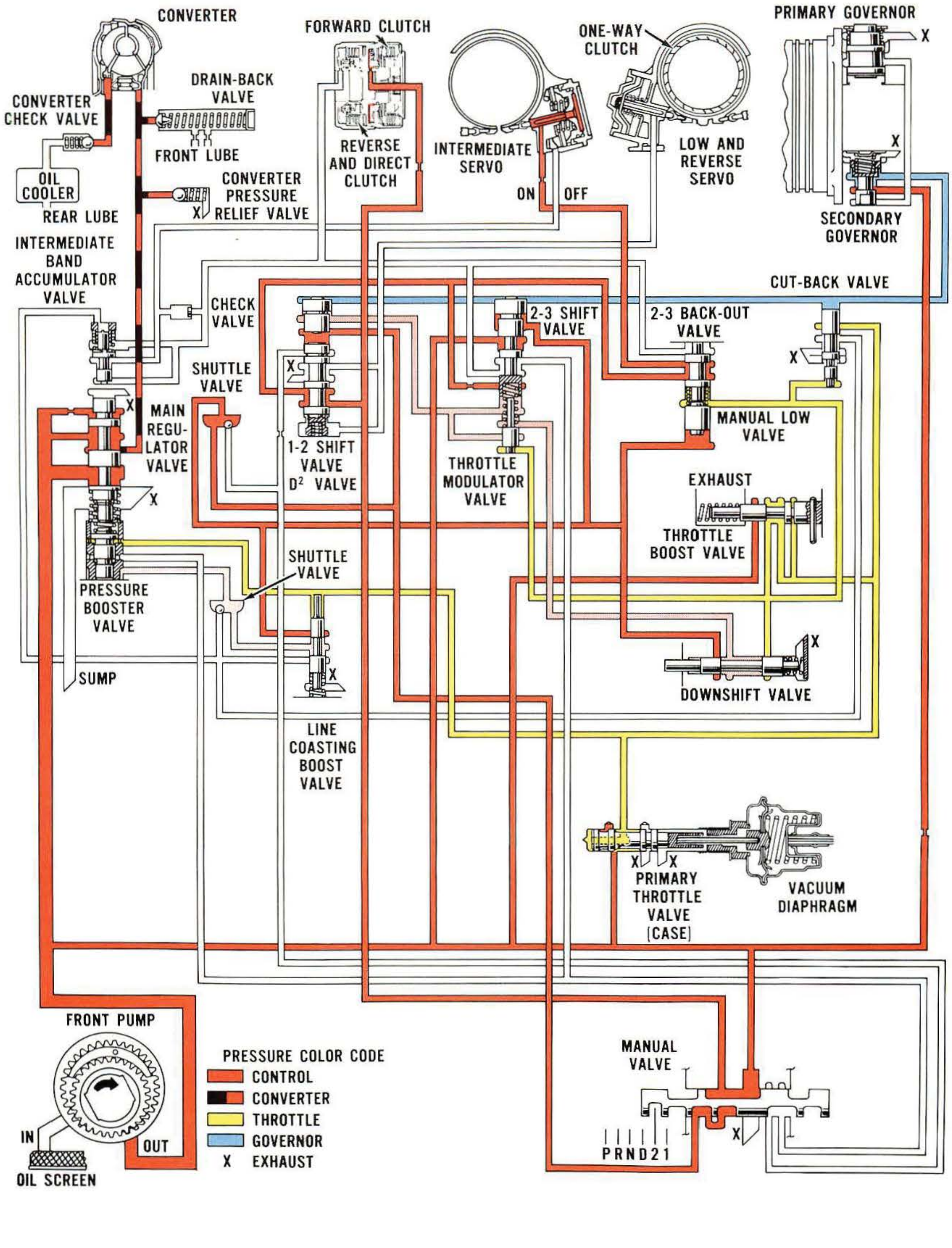
FIRST GEAR 1 – BEFORE CUTBACK
CAR STARTED IN 1

SECOND GEAR 2

In this diagram, our interest is in control pressure regulation in 2 (and 1) after cutback.

After cutback, throttle pressure can work at the main booster valve at only one place. Line coasting boost pressure can also work at the main booster valve at the same time as throttle pressure is working there. Recall, however, that the upper (primary) throttle pressure and coasting boost pressure are interlocked. As throttle pressure goes above 40 psi (10 inches of vacuum), line coasting boost pressure goes down. Above 10 inches of vacuum in 2 and 1 after cutback, control pressure is regulated to approximately the same values as in D.

A maximum of 80-psi throttle pressure can work at one place on the main pressure booster valve and produce a maximum control pressure of about 110 psi.



SECOND GEAR 2–AFTER CUTBACK–VACUUM 12"

2 TO 1 MANUAL SHIFT

This diagram shows the hydraulic control system operation after a manual shift from 2 to 1. Before the shift started, the transmission was in second gear, road speed was 25 mph, and the throttle was closed.

When the manual valve moves from 2 to 1, two control pressure circuits are affected. The control pressure, which had been holding the D2 valve down and supplying the line coasting boost valve, is exhausted at the manual valve. The control pressure passage to the low and reverse servo and to supply the line coasting boost, downshift, and manual low valves are charged.

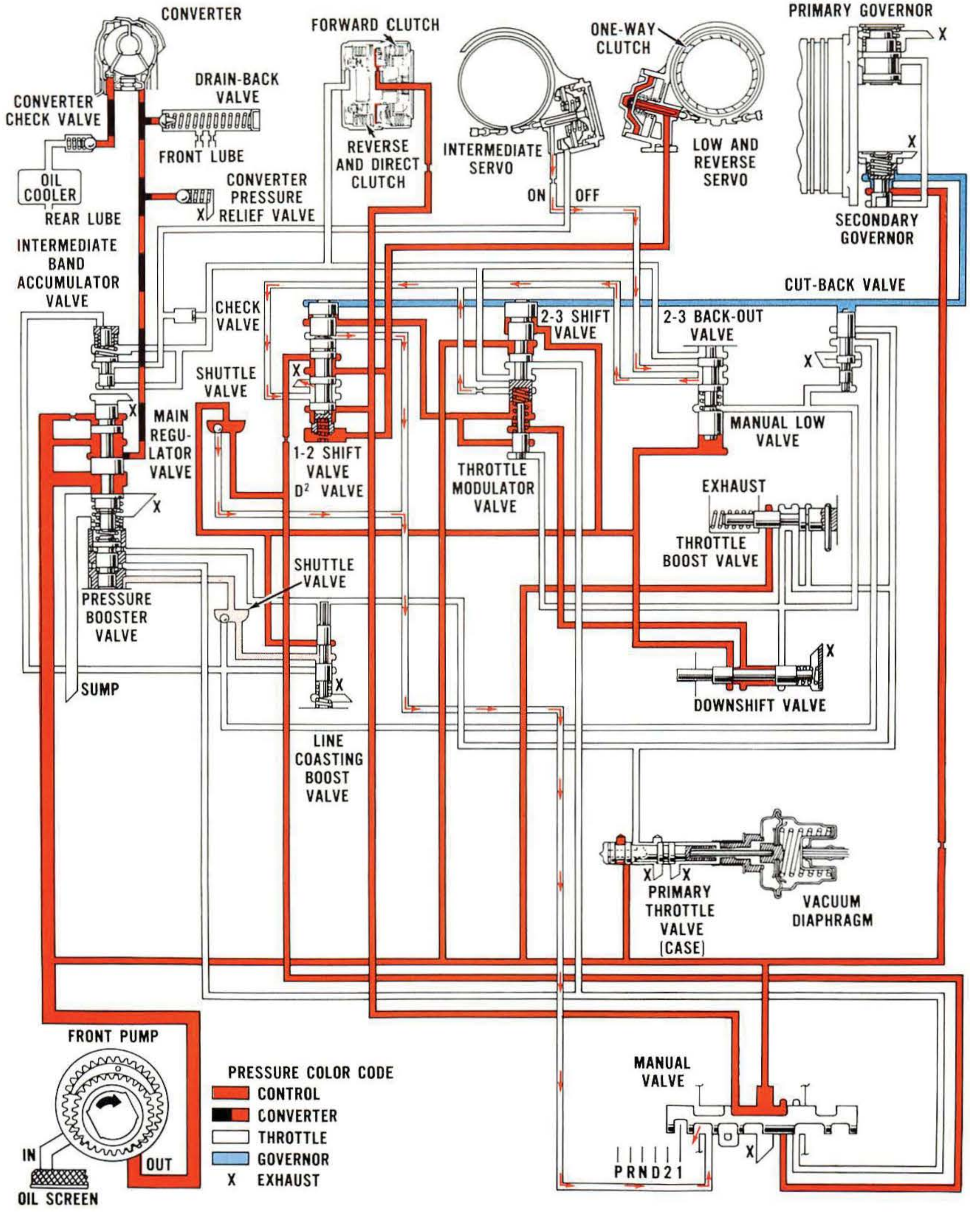
Downshift pressure raises the 1-2 valve against governor pressure, and the D2 valve is raised by its spring. As soon as the low and reverse servo applies the band, the transmission will be in first gear.

With closed throttle in second gear at 25 mph, manifold vacuum will be more than 20 inches, therefore, there is no throttle pressure.

Line coasting boost pressure will be maximum (about 80 psi). Control pressure will be about 100 psi.

Downshift pressure is shown in solid red, because control pressure is not reduced until it reaches about 120 psi.

Downshift pressure has hydraulically locked both shift valves in their rest positions.



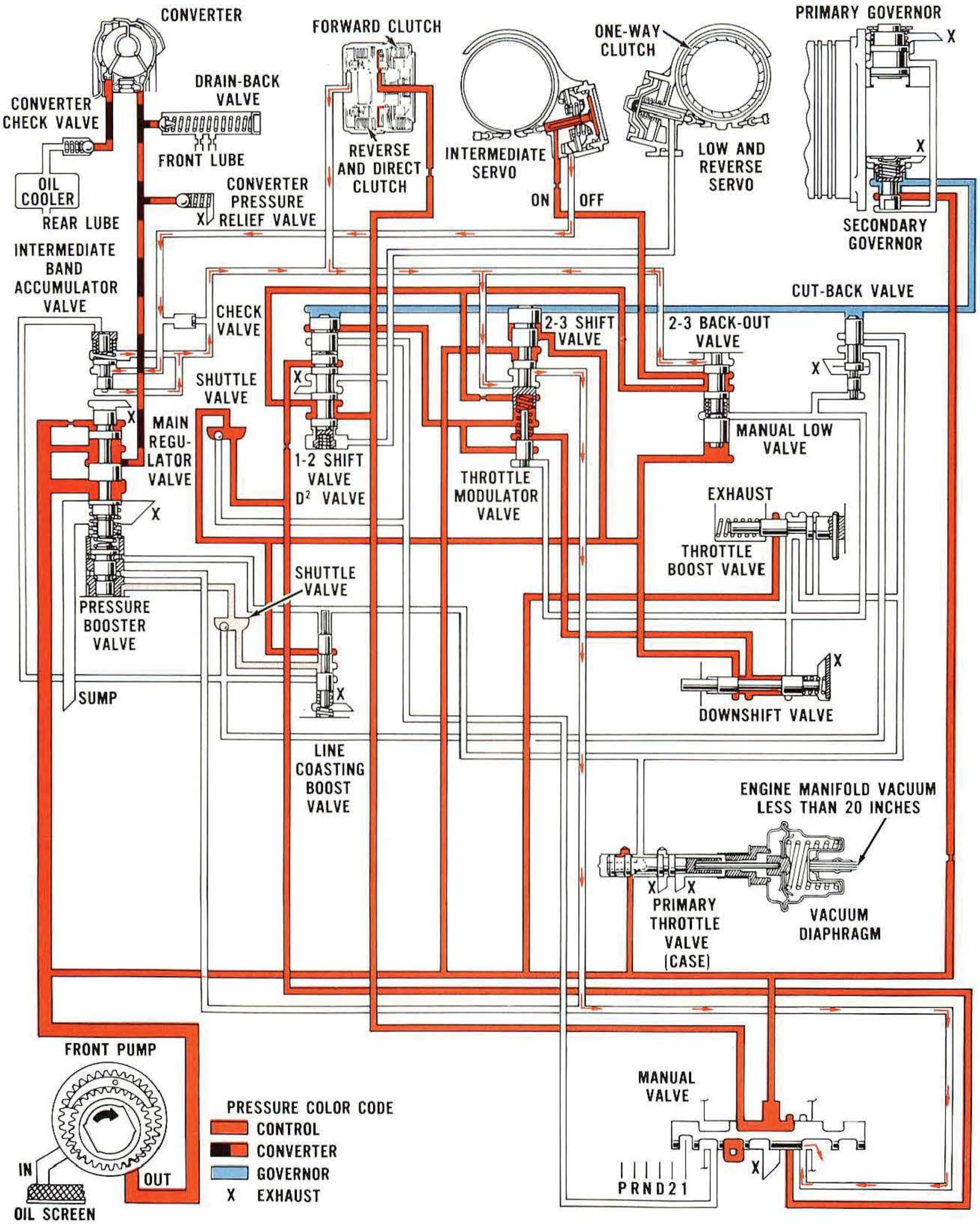
MANUAL SHIFT 2 TO 1 AT 25 MPH AND CLOSED THROTTLE

D TO 1 MANUAL SHIFT

When a D to 1 manual shift is made at 50 mph, the transmission shifts to 2 rather than 1. At 50 mph, downshift pressure cannot raise the 1-2 shift valve against governor pressure, but it can raise the 2-3 valve against governor pressure. When the 2-3 valve moves up, reverse and high clutch apply and intermediate servo release pressure is exhausted. The intermediate band comes on and the transmission is in second gear.

Should road speed drop to about 35 mph, downshift pressure will raise the 1-2 shift valve against governor pressure. The D2 valve will then move up to exhaust the intermediate servo apply pressure and fill the low and reverse servo for first gear.

Control pressure regulation is the same in this shift as it was illustrated on chart page 7500.1-19.



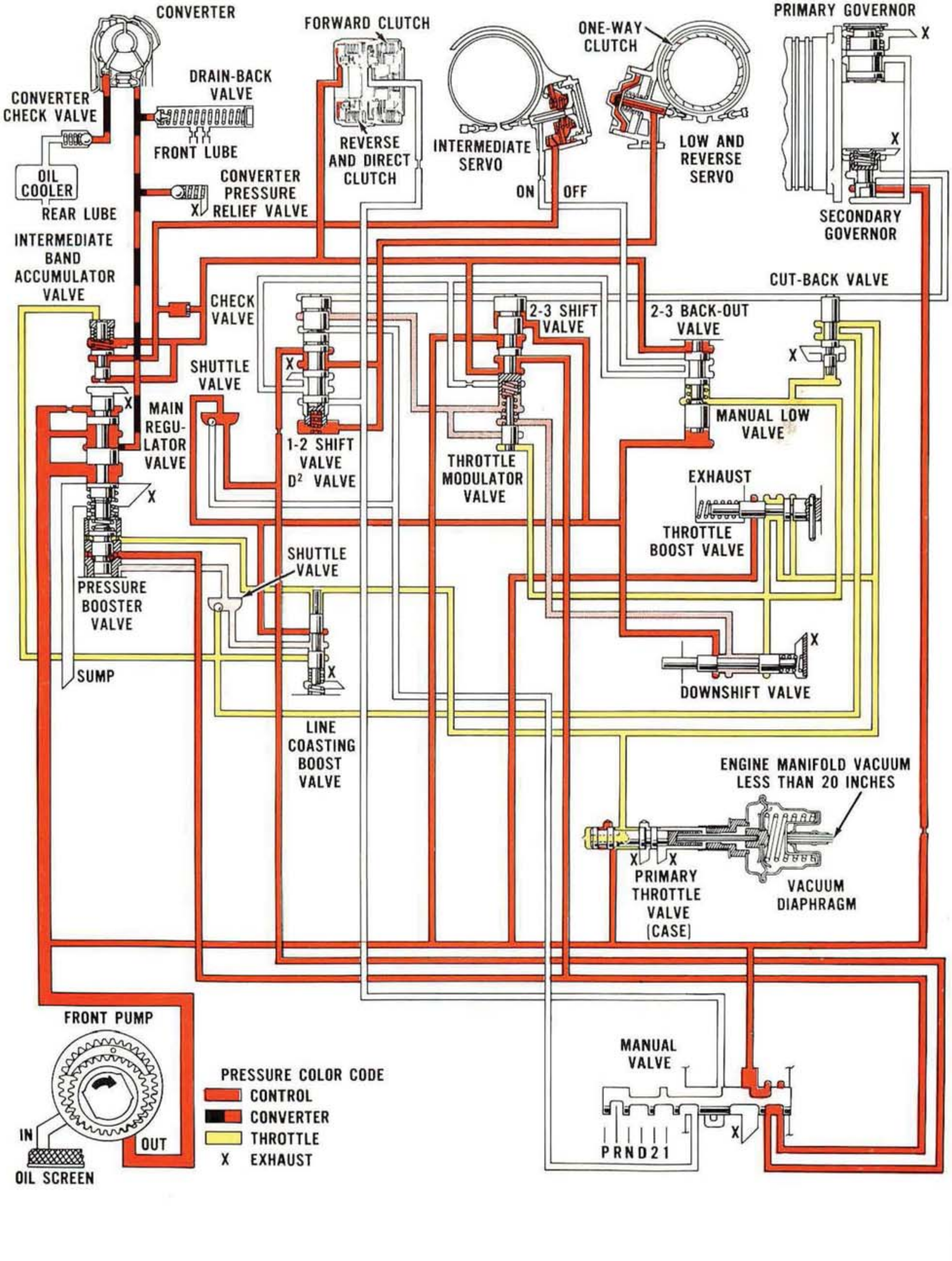
MANUAL SHIFT D TO 1 – SHIFT STARTED AT 50 MPH IN HIGH GEAR AND CLOSED THROTTLE

REVERSE

When the manual valve is shifted to R, the reverse and high clutch and the low and reverse servo are applied.

Since a higher control pressure is required in reverse, full control pressure works at the main pressure booster valve.

Should road speed go above 10 mph in reverse, governor pressure will be produced, since governor supply pressure is not cut off in reverse. Governor pressure will not be able to shift the shift valves, because of the downshift and control pressure forces working at the shift valves against governor pressure.



REVERSE AT 5 MPH—MODERATE THROTTLE

NOTES

C4 TRANSMISSION

DIAGNOSIS, ADJUSTMENT and LIGHT REPAIR

SERVICE
FORD MOTOR COMPANY
TRAINING

COURSE 7501.3

FOREWORD

Material in these instructor's notes has been developed to assist you in making an effective presentation. A list of the necessary training aids, along with tool and equipment requirements, is included. The suggested time schedules will aid you in scheduling your training sessions. Details of classroom and shop area organization are provided to enable you to make advance preparations in these areas.

In keeping with our policy of standardized training, a lesson plan has been prepared for each unit of instruction. This plan is intended as a guide for the overall presentation. Separate columns are used to list those items which must be covered by the instructor, and a check on subject coverage is given in the columns headed "What the Technician Should Know" and "What the Technician Should Be Able To Do." A column headed "Assignments" lists those operations which will provide the necessary manipulative skills and experiences.

Examination questions have been included as a section, and the use of these questions will give the instructor a valuable insight into the effectiveness of his training. The main body of notes is not intended to be used verbatim, but as a set of "lead-in" statements to stimulate classroom discussion and technician participation. No effort has been made to structure these materials so rigidly as to cause the instructor to lose his individuality. Each instructor is expected to take these materials and develop a presentation which will best fit his particular situation.

SUGGESTED TRAINING UNIT TIME SCHEDULE

Chart presentation	30 minutes
Throttle linkage adjustment	20 minutes
Manual-shift linkage adjustment	20 minutes
Neutral start switch adjustment	10 minutes
Band adjustments	30 minutes
Diagnosis	
• Control pressure	60 minutes
• Clutches and bands	40 minutes
Recap and examination	30 minutes
TOTAL TIME	4 hours

ORGANIZATION OF CLASSROOM AND SHOP AREA

Adequate seating	Clear area for test cars
Proper lighting	Exhaust outlet
Adequate ventilation	Compressed air
Pencils and paper for Technicians	Hoist
Chart stand	Chalkboard

TRAINING AIDS REQUIRED

Flip Chart 7501.3	Failed clutches and bands

TOOLS AND EQUIPMENT REQUIRED

Transmission pressure gauge	Common hand tools
Vehicles equipped with Cruise-O-Matic	Oil drain pan
Inch-pound torque wrench	Transmission fluid
Fender covers	1/4-inch gauge pin
	Tool T59P-77370-B

LESSON PLAN

WHAT THE TECHNICIAN SHOULD KNOW	WHAT THE TECHNICIAN SHOULD BE ABLE TO DO	DISCUSSION TOPICS	ASSIGNMENTS
Why is it important to follow recommendations for adding fluid.	Explain the reasons for the recommendations.	Fluid requirements.	List possible results of improper "add to" procedure.
Nature and location of throttle linkage adjustments.	Determine need for adjustment.	Throttle linkage adjustment procedure.	Adjust throttle linkage.
Procedures for making adjustments. Location of adjustments.	Perform manual-shift linkage adjustments.	Manual-shift linkage adjustments.	Adjust manual-shift linkage.
Location of adjustment points. Need for adjustment.	Adjust the neutral start switch.	Neutral start switch adjustment.	Check neutral start switch adjustment.
Band adjustment procedures. Use of special tools.	How to adjust bands.	Band adjustment procedures.	Adjust bands: • Intermediate • Low and Reverse
How pressure checks are made. Meaning of test results.	Relate test results to cause of malfunction.	Control pressure checks.	Check control pressures in all positions.
How control pressure is changed. Effect of improper control pressure.	Recognize need for control pressure adjustment.	Control pressure adjustment.	Adjust control pressure.
Clutch and band application for each drive condition.	Relate clutch and band operation to malfunction.	Clutch and band diagnosis.	List clutch and band relationship.

SUGGESTED EXAMINATION

This suggested examination is based on material in this course. An answer key is provided following the last question.

Select any or all of the questions as an examination for Service Technicians.

1. The low and reverse band adjustment mileage interval is:
   a. 24,000 miles
   b. 36,000 miles
   c. as required

2. On the Ford car, the throttle linkage is adjusted:
   a. at wide-open throttle
   b. at closed throttle
   c. from a 4-1/4 inch accelerator pedal height

3. A detent is installed in the throttle linkage to:
   a. provide a steady rest for the drivers foot at heavy-throttle operation
   b. warn the driver when the pedal is at maximum carburetor, and that further pedal depression will bring in a downshift
   c. provide an overrun so that the carburetor throttle valve does not "jam" in its wide-open position

4. The manual valve locating detent is:
   a. in the linkage at the top of the steering column
   b. a rooster comb plate linked to the manual valve by the park toggle rod
   c. directly on the manual valve

5. The neutral start switch will seldom require adjustment, because the:
   a. manual-shift linkage is spring-loaded to compensate for wear
   b. switch is attached directly to the transmission manual lever
   c. manual linkage compensates for seasonal temperature changes

6. Control pressure rise should start at a vacuum gauge reading of about:
   a. 20 inches
   b. 17 inches
   c. 10 inches

7. A stall test for slippage in D2 tests the:
   a. converter, the intermediate band and the one-way clutch
   b. converter, the forward clutch and the one-way clutch
   c. converter, the forward clutch and the intermediate band

8. If the diaphragm unit push-rod is left out at assembly, the transmission will:
   a. always shift at the high limit (road speed)
   b. always shift at the low limit (road speed)
   c. downshift 3-2-1 on a coastdown

9. The C4 Cruise-O-Matic cannot be locked into first or second gear by tightening a band as can be done on the 2-speed Fordomatic, because the:
   a. intermediate band holds the reverse and high clutch drum
   b. forward clutch cylinder is splined to the input shaft
   c. only way power can flow from the converter and into the gear train is through one or both multiple-disc clutches

10. If the selector lever is moved to L with the car going 80 mph in high gear, the transmission will:
    a. stay in high
    b. downshift to imtermediate
    c. downshift to first

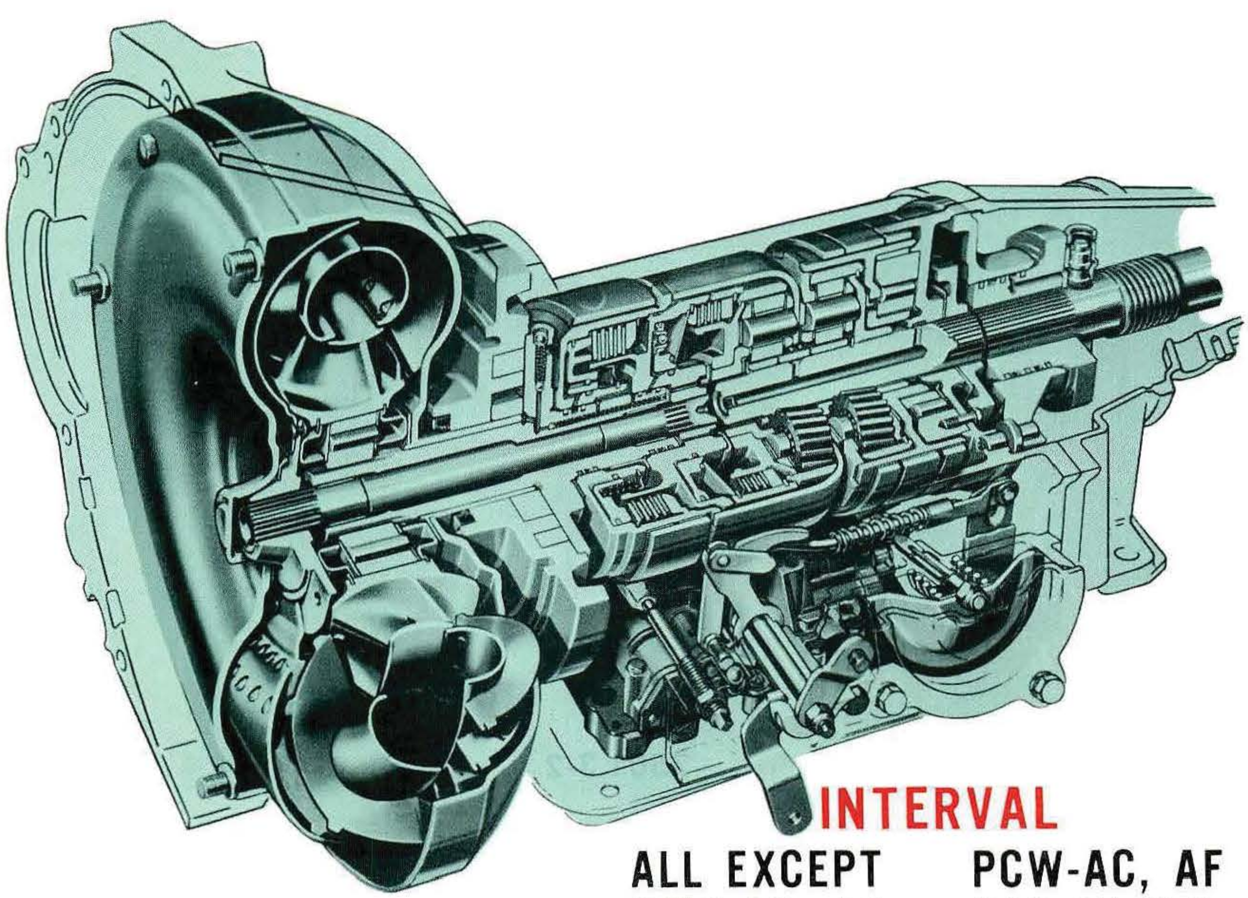
ANSWER KEY

1.—b	3.—b	5.—b	7.—c	9.—c
2.—a	4.—c	6.—b	8.—b	10.—b

7501.3-1

TRANSMISSION FLUID

Use only automatic transmission fluids having a Ford Qualification Number indicating fluid meets Ford specifications.



INTERVAL

	ALL EXCEPT PCW-AC, AF	PCW-AC, AF 289-4V H.P.
● CHECK FLUID LEVEL	6,000 MILES	6,000 MILES
● ADJUST INTERMEDIATE BAND	36,000 MILES	6,000 MILES
● ADJUST REVERSE BAND	AS REQUIRED	12,000 MILES
● LUBRICATE KICKDOWN LINKAGE	6,000 MILES	6,000 MILES

FLUID CAPACITIES—APPROXIMATE

MODELS PCS	7¾ QUARTS
MODELS PCW-AA, AC, AD, AF, J, M	8¾ QUARTS
MODELS PCV, PCW-AG,R, S; PCZ; PDA	10¼ QUARTS
MODELS PCW-AH	10½ QUARTS

TRANSMISSION MAINTENANCE

FORD MOTOR COMPANY SERVICE TRAINING

7501.3-2

THROTTLE LINKAGE ADJUSTMENT

FALCON AND COMET

1. With the engine at normal operating temperature, adjust the engine idle speed 475-500 rpm, with the selector lever in D1 or D2. **Apply the parking brake firmly prior to making this adjustment.**

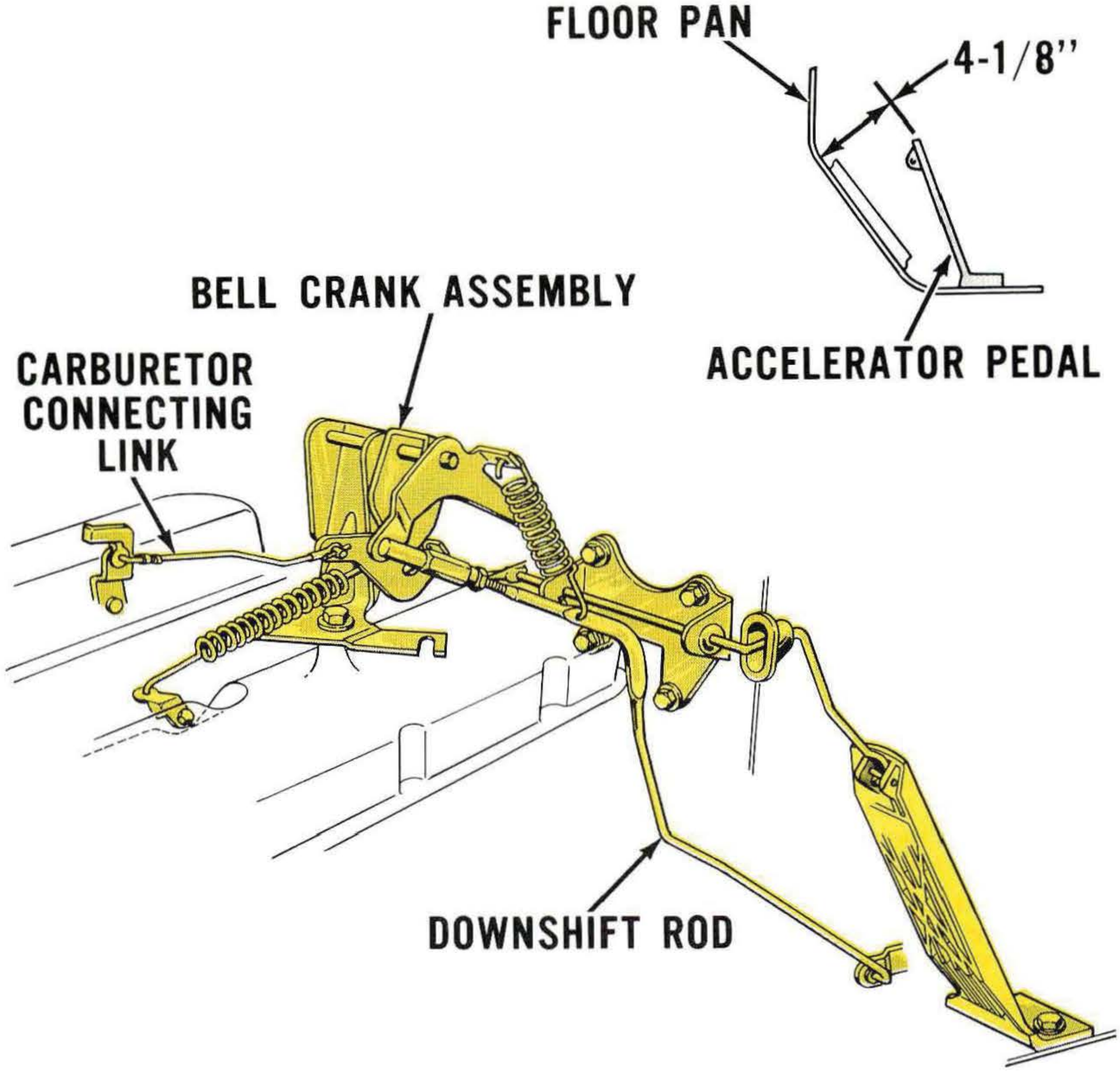
2. Bottom the dashpot plunger, and check the clearance between the bottomed plunger and the carburetor throttle lever. The throttle lever must be against its idle stop during this check. If necessary, adjust to a clearance of 0.060-0.090 inch.

3. Adjust the accelerator connecting link to obtain a pedal height of 4-1/8 inches.

4. With the engine off, push the accelerator pedal down against the floor and hold it there. Insert a block of wood between the instrument panel lower flange and the pedal.

5. Disconnect the downshift rod from the bell crank assembly. Hold the downshift rod firmly downward so that the downshift transmission lever is against its internal stop. In this position, adjust the downshift rod trunnion so that it enters the bell crank assembly lever easily. Connect the trunnion and tighten the locknut.

6. Release the accelerator pedal and install the return spring.



FALCON—COMET THROTTLE LINKAGE

THROTTLE LINKAGE ADJUSTMENT—Contined

FAIRLANE

1. With the engine at normal operating temperature, adjust the engine idle speed to 475-500 rpm, with the selector lever in D1 or D2. **Apply the parking brake firmly prior to making this adjustment.**

2. Bottom the dashpot plunger, and check the clearance between the bottomed plunger and the carburetor throttle lever. The throttle lever must be against its idle stop during this check. If necessary, adjust to a clearance of 0.060-0.090 inch.

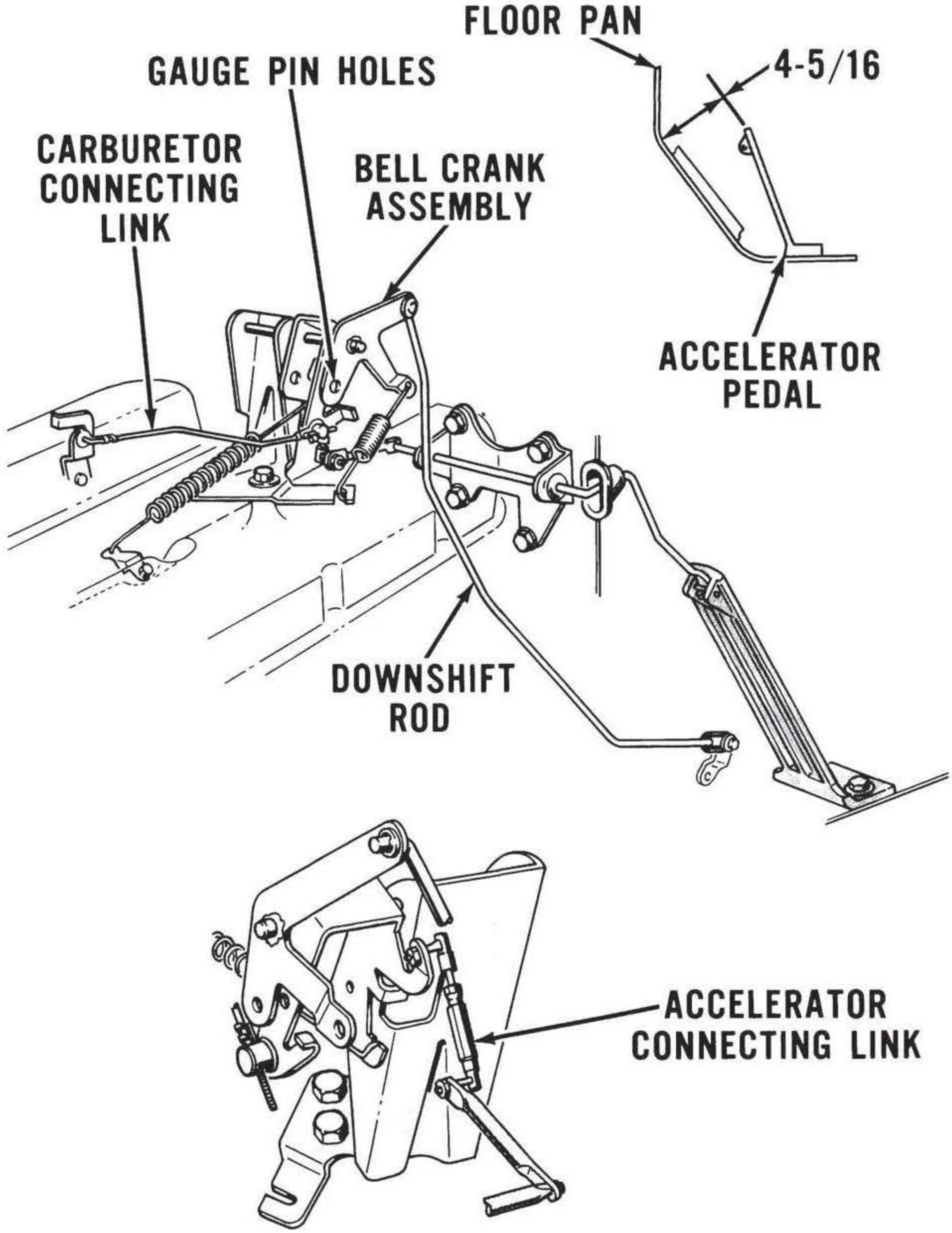
3. Disconnect the carburetor connecting link from the bell crank assembly, and insert a 1/4-inch gauge pin through the gauge pin holes.

4. Lift the carburetor connecting link to its operating position. Maintain forward pressure on it so that the carburetor throttle lever is held solidly against the idle adjusting screw. With forward pressure on the link, adjust it length so that it can be freely assembled to the bell crank lever. Lengthen the link one thread from this free-fitting position. Remove the gauge pin and connect the link.

5. Check the alignment of the gauge pin holes. Open the throttle, and permit the throttle linkage retracting spring to return the linkage to it idle position. The gauge pin must enter freely. If necessary, readjust the carburetor connecting link to obtain free entry for the gauge pin.

6. Adjust the accelerator connecting link to obtain a pedal height of 4-5/16 inches.

7. The downshift rod is not adjustable.



FAIRLANE THROTTLE LINKAGE

THROTTLE LINKAGE ADJUSTMENT—Continued

FORD 6-CYLINDER ENGINE

1. Adjust engine idle speed to 475-500 rpm in D2 or D1. Adjust the dashpot.

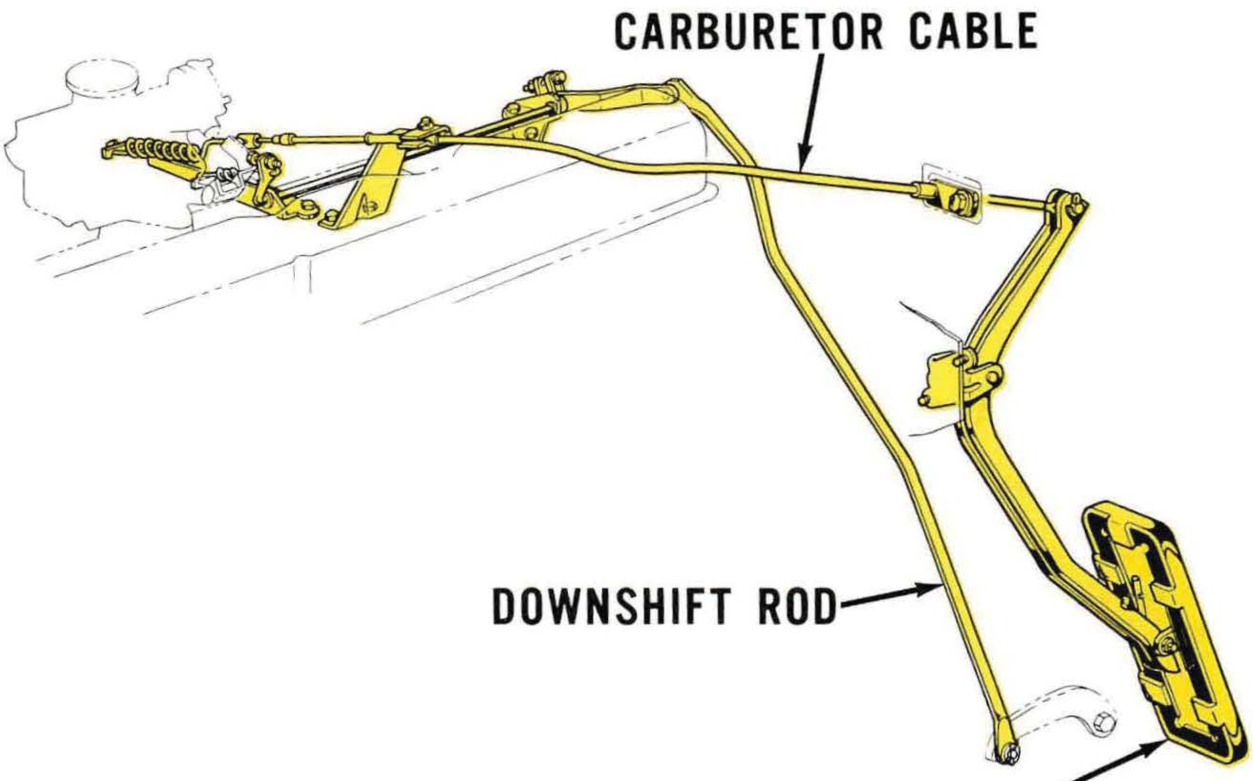
2. Stop the engine and unhook the throttle linkage return springs. Loosen the carburetor cable conduit clamp.

3. Push the accelerator pedal down until it touches the floor and secure it in this position.

4. Pull the carburetor cable conduit through the clamp until the carburetor throttle shaft lever is against it wide-open stop. Tighten the clamp with the throttle wide open.

5. Push downward on the downshift rod until the transmission downshift lever is against its internal stop. Hold it against its stop and adjust the downshift lever adjusting screw to take up all clearance at the carburetor throttle shaft lever. Lock the adjusting screw in this position.

6. Release the accelerator pedal and hook up the return springs.



FORD THROTTLE LINKAGE
6-CYLINDER

THROTTLE LINKAGE ADJUSTMENT—Continued

FORD 289 V-8 ENGINE

1. Adjust the engine idle speed to 475-500 rpm in D2 or D1. Adjust the dashpot.

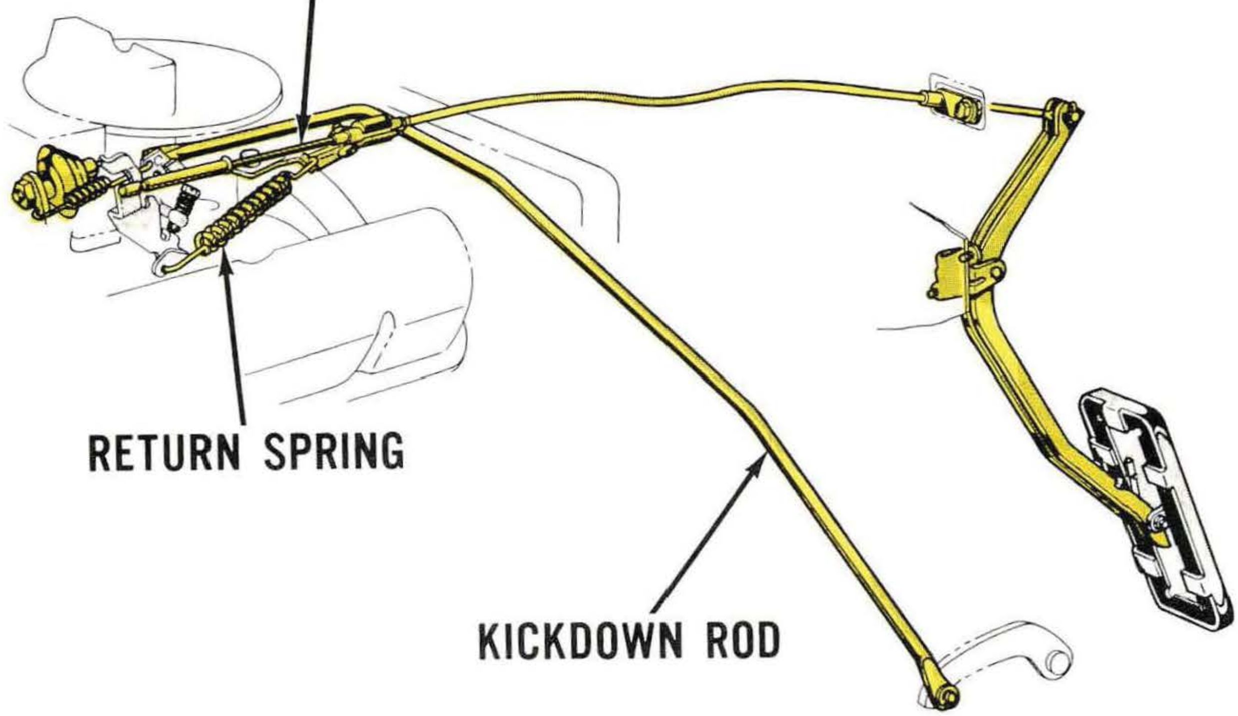
2. Stop the engine and unhook the throttle linkage return springs. Loosen the carburetor cable conduit clamp.

3. Push the accelerator pedal down until it touches the floor and secure it in this position.

4. Pull the carburetor cable conduit through the clamp until the carburetor throttle shaft lever is against its wide-open stop. Tighten the clamp with the throttle wide open.

5. Push downward on the downshift rod until the transmission downshift lever is against its internal stop. Hold it against its stop and adjust the downshift lever adjusting screw to take up all clearance at the carburetor throttle shaft lever. Lock the adjusting screw in this position.

6. Release the accelerator pedal and hook up the return springs.



FORD 289 CID THROTTLE LINKAGE

THROTTLE LINKAGE ADJUSTMENT—Continued

MUSTANG 6- and 8-CYLINDER ENGINE

1. Adjust the engine idle speed to specifications.

2. **With the engine stopped and the accelerator pedal in normal idle position,** check the pedal for a height of 3-7/8 inches. **Be sure the fast idle cam is not contacting the fast idle adjusting screw of the carburetor.**

3. To check for free pedal travel, depress the accelerator pedal to the full-throttle position (carburetor throttle lever against full-throttle stop). Release the pedal and recheck the pedal height.

4. If necessary, adjust the accelerator pedal height as follows:

On 6-cylinder engines, disconnect the carburetor return spring and carburetor rod. Adjust the length of the rod to bring the pedal height within specifications. Connect the carburetor rod and tighten the jam nut. Install the return spring.

On V-8 engines, disconnect the carburetor return spring and the carburetor rod at point "C". Adjust the length of the rod to bring the pedal height within specifications. Connect the carburetor rod and return spring.

5. If necessary, adjust the transmission kickdown linkage as follows:

On 6-cylinder engines, disconnect the kickdown cable return spring at the transmission. Disconnect the carburetor return spring at the manifold. Disconnect the kickdown cable at Point "A".

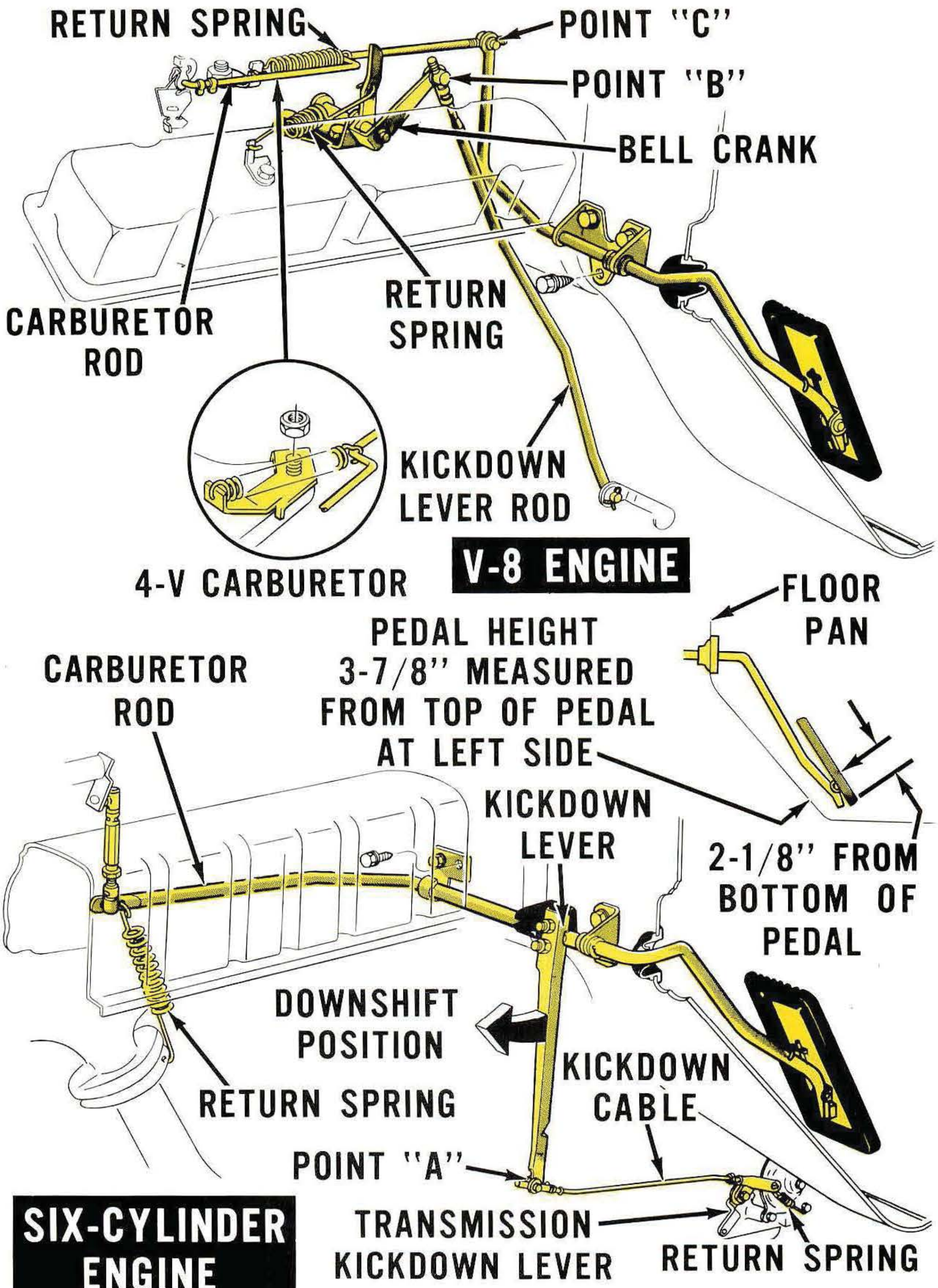
Position the kickdown lever in the downshift position (carburetor-wide open position). Hold the kick-down lever on the transmission against the stop, in a counterclockwise direction (kickdown position).

Adjust the trunnion at point "A" on the kickdown cable so that it aligns with the hole in the kick-down lever, then install the attaching clip. Install the return springs.

On 8-cylinder engines, disconnect the kickdown return spring at the bell-crank. Disconnect the carburetor return spring.

Disconnect the kickdown lever rod at point "B". Hold the carburetor rod in the wide-open throttle position. The step in the rod should place the bell crank in the downshift position. Hold the kickdown lever rod in the downward position. This positions the transmission lever in the downshift position.

Adjust the kickdown lever trunnion at point "B" so that it aligns with the hole in the bell crank. Install the trunnion and retaining clip. Release the levers and install the carburetor rod and bell crank return springs.



MUSTANG THROTTLE LINKAGE

SERVICE FORD TRAINING

7501.3-5A

THROTTLE LINKAGE ADJUSTMENT—Continued

ECONOLINE

1. With the engine at normal operating temperature, adjust the engine idle speed to 475-500 rpm, with the selector lever in D1 or D2. **Apply the parking brake firmly prior to making this adjustment.**

2. Bottom the dashpot plunger and the carburetor throttle lever. The throttle lever must against its stop during this check. If necessary, adjust to a clearance of 0.060-0.090 inch.

3. With the engine off, disconnect the rod from the lever at "A". With the accelerator pedal down against the floor and the carburetor throttle valve wide open, adjust the rod length so that the rod will freely assemble to the lever. Now, shorten the rod one thread and assemble it to the lever.

4. Disconnect the rod from the lever at "B". With the carburetor throttle valve wide open and the rod pulled all the way forward, adjust the rod length for a free fit to the lever. Assemble the rod to the lever at its free fit length.

MANUAL-SHIFT LINKAGE ADJUSTMENT

ECONOLINE

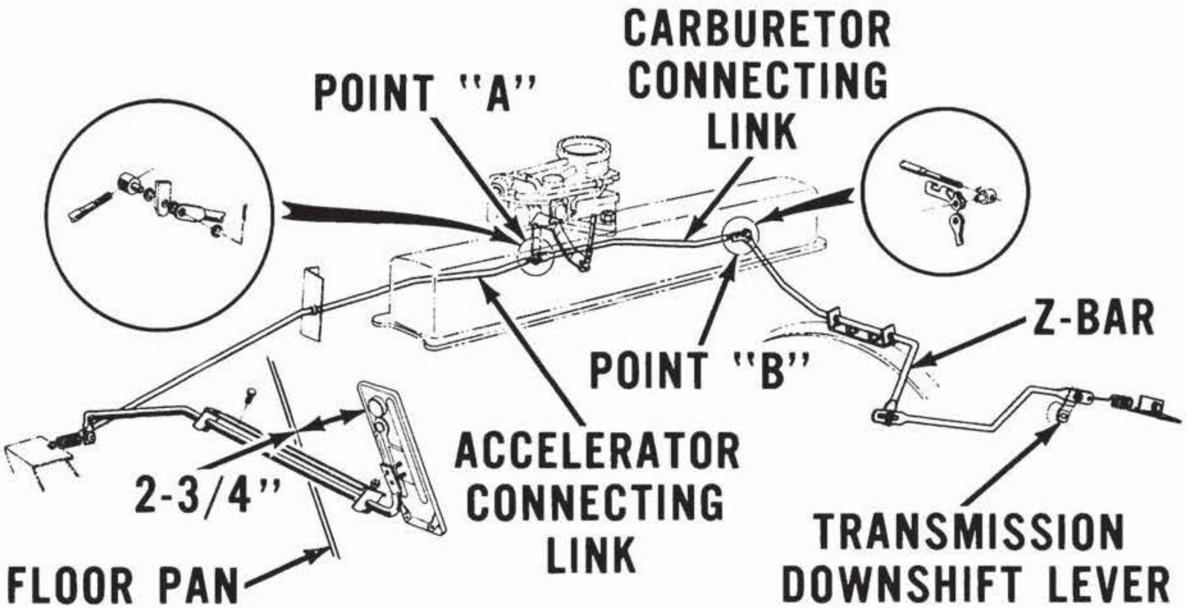
1. Disconnect the shift rod from the transmission manual-shift lever.

2. Move the transmission manual-shift lever to neutral, the fourth detent from the rear, or three "clicks" from the rear.

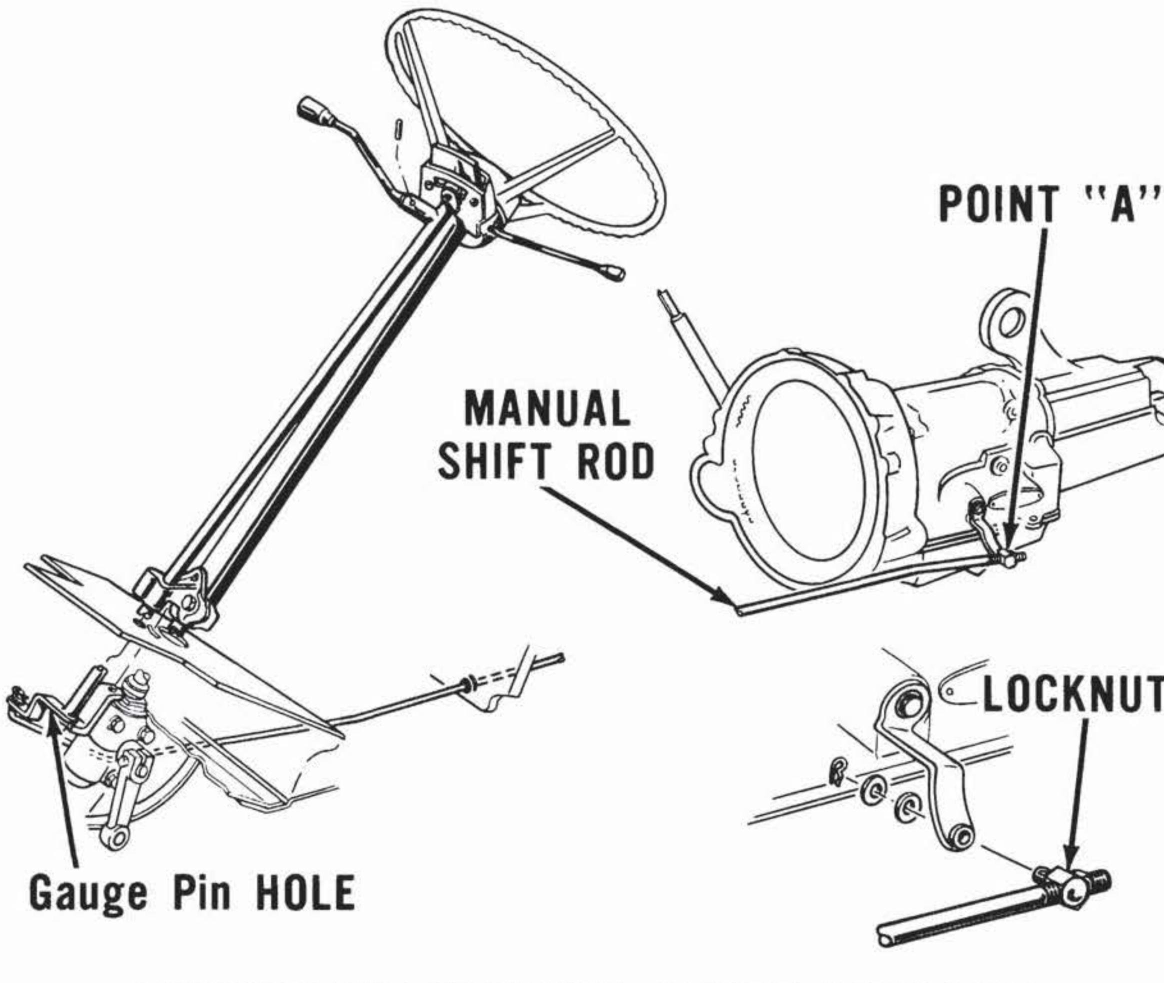
3. Move the selector lever to N, and insert a 1/4-inch pin through the shift tube lever and into the steering column bracket.

4. Adjust the shift rod length so that it freely fits into the transmission shift lever, then lengthen the rod one thread.

5. Assemble the rod to the lever, and check the manual-shift linkage operation in all positions.



ECONOLINE THROTTLE LINKAGE



ECONOLINE MANUAL-SHIFT LINKAGE

THROTTLE LINKAGE ADJUSTMENT—Continued

F-100 AND F-250 TRUCKS

1. Adjust the engine idle speed to 475-500 rpm in D1 or D2. Adjust the dashpot.

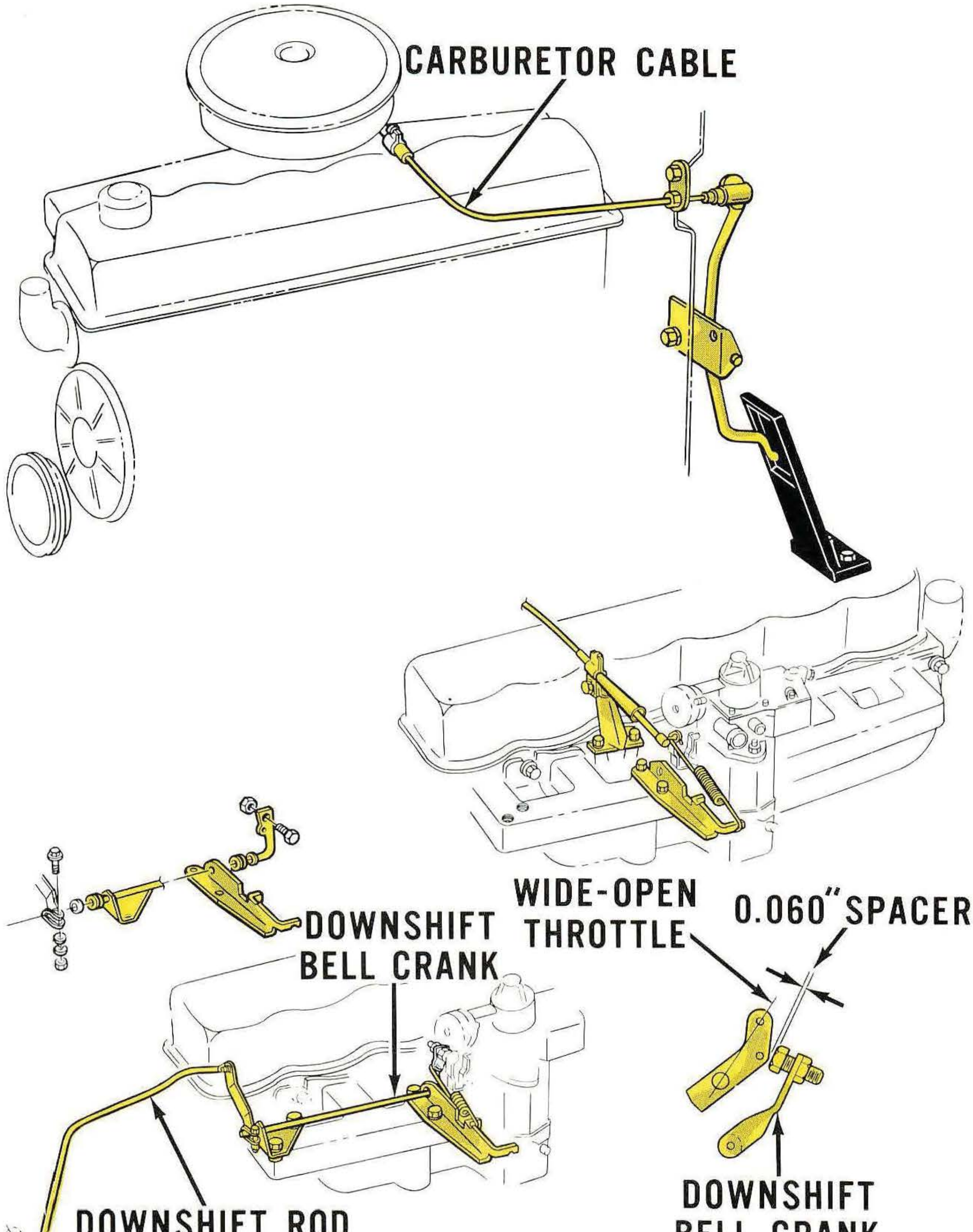
2. Stop the engine and unhook the throttle linkage return springs. Loosen the carburetor cable conduit clamp.

3. Push the accelerator pedal down until it touches the floor and secure it in this position.

4. Pull the carburetor conduit through the clamp until the caburetor throttle shaft lever is against its wide-open stop. Tighten the clamp with the throttle wide open.

5. Push downward on the downshift rod until the transmission downshift lever is against its internal stop. Hold the downshift rod in this position. Insert a 0.060-inch feeler gauge between the downshift lever adjusting screw and the carburetor throttle shaft lever. Adjust the screw to zero clearance against the feeler gauge.

6. Remove the feeler gauge, release the accelerator pedal, and hook up the return springs.



THROTTLE LINKAGE ADJUSTMENT
F-100 AND F-250

FORD MOTOR COMPANY SERVICE TRAINING

7501.3-6A

7501.3-6B

SELECTOR LEVER REMOVAL ADJUSTMENT AND INSTALLATION

1. Raise the car and remove the manual lever control rod retaining nut.

2. Lower the car, remove the selector lever handle retaining screw.

3. Remove the dial housing retaining screws and the housing.

4. Remove the selector lever plate retaining screws and the plate.

5. Disconnect the dial indicator light.

6. Remove the selector housing and lver assembly retaining bolts. Remove the selector lever and housing.

7. Remove the selector lever to housing retaining nut. Remove the lever from the housing.

8. Install the selector lever in the housing and install the retaining nut. Torque the nut to 20-25 ft-lbs.

9. Install the dial indicator light.

10. Install the selector lever handle.

11. Position the selector lever as shown in view "A". With a feeler gauge, check the clearance between the detent pawl and plate. The clearance should be 0.005 to 0.010 inch. If necessary, adjust the height of the detent pawl as shown in View "B".

12. Remove the handle from the selector lever.

13. Install the selector housing and lever assembly. Torque the retaining bolts 8-12 ft-lbs.

14. Connect the dial indicator light wires.

15. Install the selector lever plate and tighten the retaining screws.

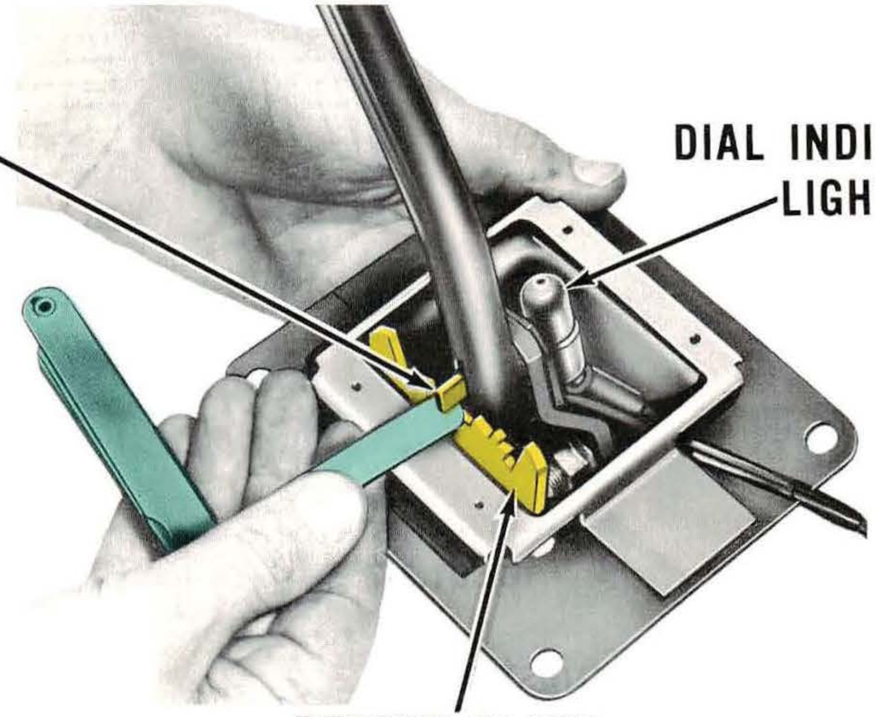
16. Install the dial housing and tighten the retaining screws.

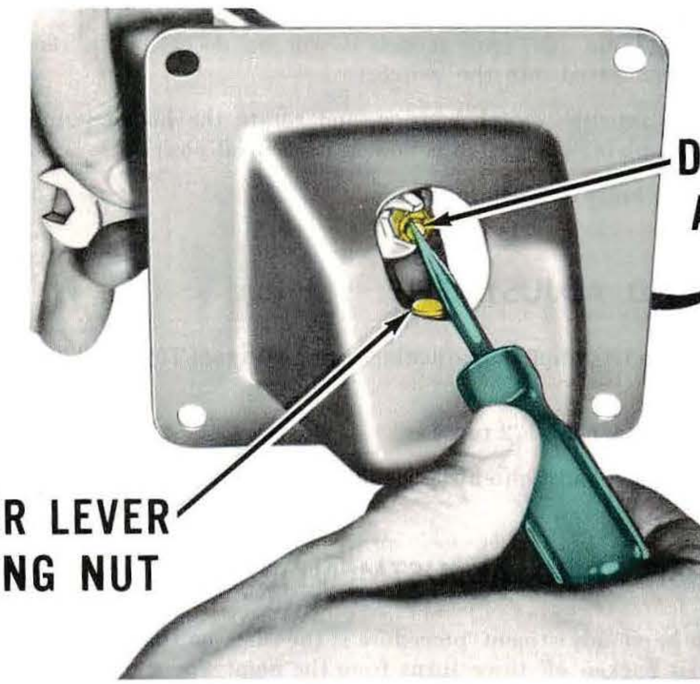
17. Install the selector lever handle and tighten the retaining screw.

18. Position the selector lever in the D-1 (large dot) position.

19. Raise the car. Install the transmission manual lever rod to the selector lever. Adjust the manual linkage.

20. Lower the car and check the transmission operation in each selector lever detent position.





SELECTOR LEVER DETENT PAWL ADJUSTMENT

7501.3-6B

7501.3-7

NEUTRAL START SWITCH ADJUSTMENT

The neutral start switch on the Cruise-O-Matic is not affected by changes in the manual-shift linkage and it should seldom require adjustment. The switch permits engine cranking in P and N only.

If adjustment is required, the mounting bolt holes are elongated to provide rotation of the switch housing in relation to the movable plate which is attached to the shift lever.

1. Loosen the mounting bolts. (On some models it will be necessary to remove the downshift lever before the gauge pin can be inserted into the switch.)

2. Insert the gauge pin into the switch housing, and rotate the housing until the pin goes into the second hole in the moveable plate. The switch is now in its neutral position.

3. Torque the attaching bolts to 35-40 in-lbs.

INTERMEDIATE BAND ADJUSTMENT

1. Loosen the locknut and tighten the adjusting screw with tool T59P-77370-B or 7345 until the wrench clicks and overruns.

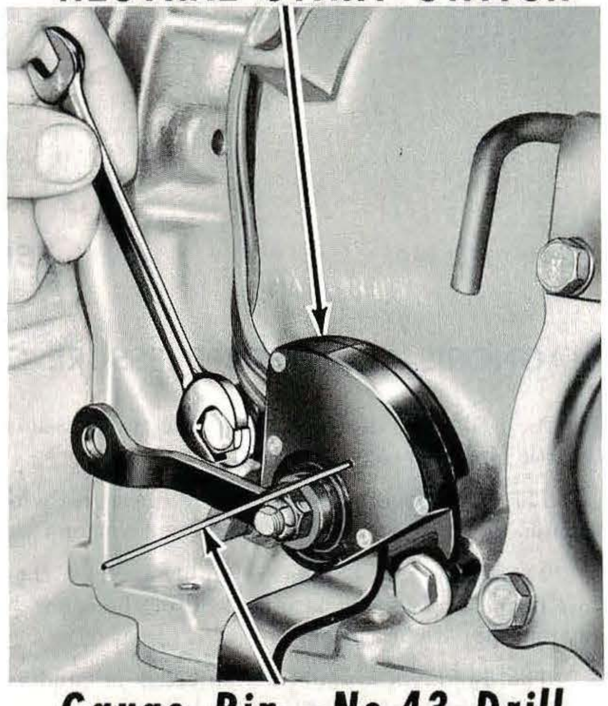
2. Back the adjusting screw off 1-1/2 turns.

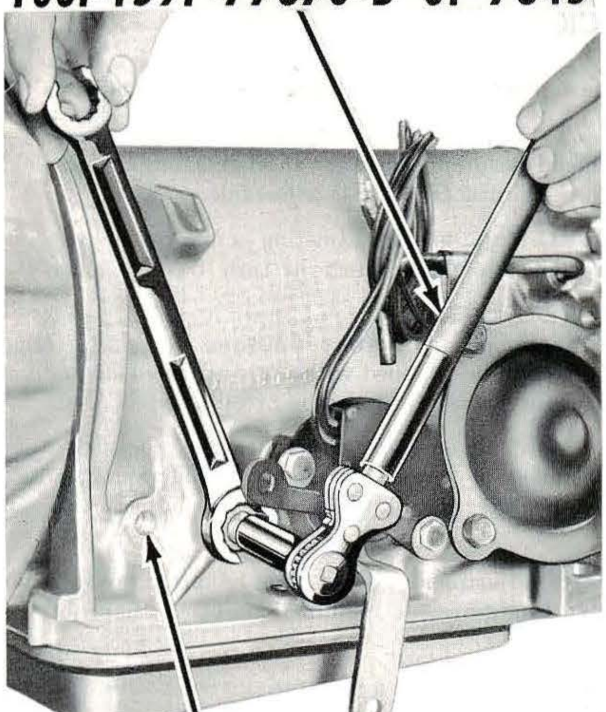
3. Hold the adjusting screw and tighten the locknut.

LOW AND REVERSE BAND ADJUSTMENT

The low and reverse band adjustment procedure is the same as that for the intermediate band except that the adjusting screw is backed off three turns from the point where the tool clicks and overruns.

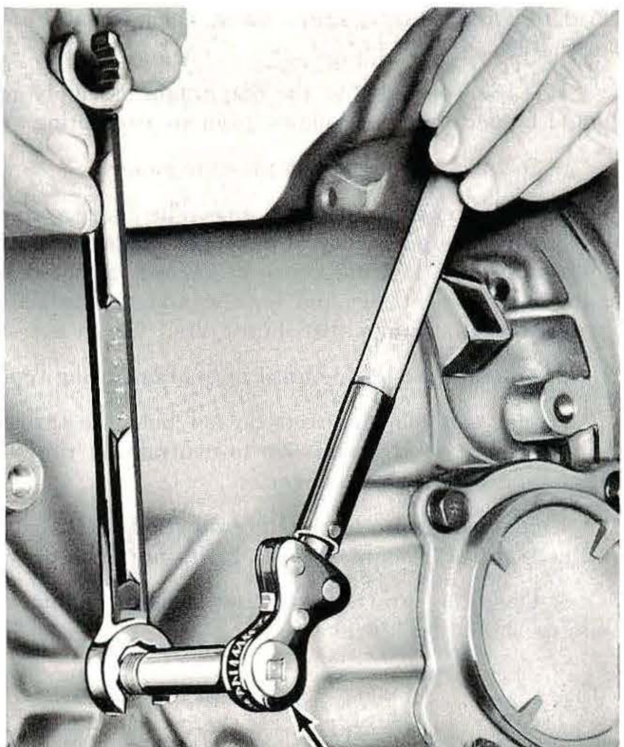
NEUTRAL START SWITCH ADJUSTMENT





INTERMEDIATE BAND ADJUSTMENT

LOW AND REVERSE BAND ADJUSTMENT



DIAGNOSIS—CONTROL PRESSURE CHECK

As in all Ford designed automatic transmissions, the control pressure in this transmission is adjusted to throttle opening (engine torque).

The chart pages gives the control pressures which should be produced at given engine intake manifold vacuum gauge readings. The diaphragm vacuum unit on the Cruise-O-Matic is adjustable.

The vacuum diaphragm assembly used on the Cruise-O-Matic has an adjusting screw in the vacuum hose connecting tube. The inner end of the screw bears against a plate, which in turn bears against the vacuum diaphragm spring.

The diphragm assembly is adjusted in production to provide the correct pressures for each transmission assembly. In addition, replacement case assemblies will be supplied with a pre-adjusted diaphragm assembly installed. Individual replacement diaphragms, for service use, will also be preadjusted.

As a consequence, diaphragm assemblies should not normally require adjustment in the field, nor should the diaphragm adjusting screw in diaphragms installed in service cases, or in individual service diaphragms, be turned. Turning the screw would destroy the integrity of the production adjustment and could make diagnosis of problems very difficult.

Diaphragm adjustment will affect shift feel. Diaphragm adjustment should not be attempted in an effort to correct erratic shifts, harsh engagements, no-drive conditions, or malfunctions other than soft or harsh shifts.

If it is suspected that the diaphragm assembly requires adjustment, a pressure-versus-vacuum check should be performed as follows, prior to attempting an adjustment:

1. Install transmission oil pressure gauge.

2. Install engine vacuum gauge. The gauge connection should be installed at the diaphragm assembly to eliminate the possibility of improper diagnosis due to leaks or restrictions in the engine induction system or vacuum lines. If a difference in vacuum is noted between readings taken at the diaphragm and at the engine manifold, fittings and lines should be checked for restrictions or leaks. In particular, check threaded fittings (vacuum brake, distributor, etc.) for an excess of sealing compound which could cause restrictions.

3. Operate the engine until normal operating temperature is reached.

During the following tests do not hold the throttle open for more than ten seconds at a time. After each test, shift the transmission to neutral and run the engine at 1000 rpm in neutral for 15 seconds to circulate fluid through the converter.

4. Place the selector in Drive range (D1, D2, or L), open the throttle until the vacuum reading is 10″, and note the transmission control pressure. The pressure should be 96 to 105 psi at 10 inches of vacuum.

5. Open the throttle until the vacuum reading is three inches and note the pressure gauge reading. The pressure should be 138-148 psi.

DIAGNOSIS—CONTROL PRESSURE CHECK—Continued

6. Shift the transmission to reverse and open the throttle until the vacuum gauge reading is three inches and note the pressure gauge reading. The pressure should be 215-227 psi at three inches of vacuum in reverse.

The following summarizes control pressure and vacuum readings that should be obtained during the tests previously described.

Engine rpm and Vacuum Gauge Readings	Throttle	Range	PSI
Idle: Above 18 (See note 1)	Closed	P, N, D1, D2, L R	55-62 55-100
As Required 17.0 Approx.	Open As Required	D1, D2, L	Line Pressure Increase (See note 2)
As Required: 10	As Required	D1, D2, L	96-105
As Required: 3	As Required	D1, D2, L R	138-148 215-227

Note 1: At altitudes above sea level it may not be possible to obtain 18 inches of engine vacuum at idle. For idle vacuums of less than 18 inches, refer to the following table to determine idle speed pressure specification in forward driving ranges (D1, D2, or L).

Engine Vacuum	Control Pressure
17″	55-62
16″	55-68
15″	55-74
14″	55-80
13″	55-87
12″	55-93
11″	55-99

DIAGNOSIS—CONTROL PRESSURE CHECK—Continued

Note 2: Line pressure increase may be noted immediately when the throttle is opened, due to increased pump output resulting from increased engine speed. If desired, the pressure rise point can be checked by using a distributor vacuum tester, as follows: Install a distributor tester vacuum line on the diaphragm assembly. Adjust the tester to provide over 18 inches of vacuum. With the engine operating at fast idle (approx. 750 rpm), reduce the tester vacuum reading through the 17.0 inch range (approx.) and observe the transmission pressure gauge for line pressure increase.

Gauge readings within the limits shown indicate that the diaphragm assembly is properly adjusted and that the hydraulic control pressure system is functioning properly.

Slightly high or slightly low readings may indicate the desireability of making an adjustment to correct a particular shift condition. For example:

If the pressure at 10 inches of vacuum was 120 psi and the pressure at three inches of vacuum was 170 psi, and upshifts and downshifts were harsh, a diaphragm adjustment to reduce diaphragm assembly spring force would be required.

Conversely, if pressure readings are low, and line pressure does not start to build up until the vacuum drops to 15 inches, an adjustment to increase diaphragm spring force is required.

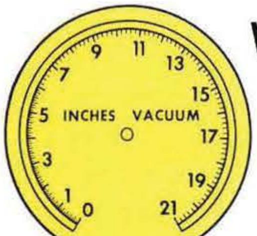
To increase control pressure, turn the adjusting screw in (clockwise). To reduce control pressure, back the adjusting screw out (turn counterclockwise).

One complete turn of the adjusting screw (360°) will change idle line control pressure approximately 2-3 psi.

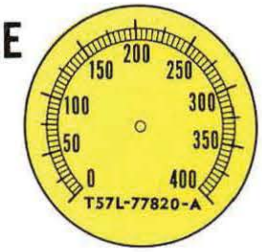
After adjustment is made, install the vacuum line and check the pressures, particularly the pressure at 10 inches of vacuum.

It is recommended that the diaphragm not be adjusted to provide pressures below the ranges previously specified for the purpose of changing shift feel. To do so could result in soft or slipping shifts.

VACUUM GAUGE



OIL PRESSURE GAUGE



CONTROL PRESSURE SPECIFICATIONS (SEA LEVEL)

THROTTLE POSITION	SELECTOR POSITION	VACUUM GAUGE	PRESSURE GAUGE
CLOSED IDLE	P, N, D2, D1, L,	18 MINIMUM	55-62
	R		55-100
AS REQUIRED	D2, D1, L	17.0 (APPROX.)	PRESSURE RISE STARTS
AS REQUIRED	D2, D1, L	10	96-105
AS REQUIRED	D2, D1, L	3	138-148
	R		215-227

IDLE PRESSURE SPECIFICATIONS (ABOVE SEA LEVEL)

VACUUM GAUGE	17	16	15	14	13	12	11
PRESSURE GAUGE	55-62	55-68	55-74	55-80	55-87	55-93	55-99

STALL SPEEDS

TRANSMISSION MODEL	ENGINE	STALL SPEED
PCS-H	170-1V	1700-1900
PCS-E	170-1V	1400-1600
PCS-F,G,J,M	170-1V	1550-1750
PCV, PCW-AG,AH	240-1V	1300-1500
PDA-C, PCW-R,S	289-2V	1450-1650
PCZ-A,E	240-1V	1300-1500
PCZ-C,F	300-1V	1550-1750
PCW-J,M,AA,AD	289-2V	1750-1950
PCW-J,M,AA,AD	289-4V	1800-2000
PCW-AC,AF	289-4V	1750-1950

SERVICE FORD MOTOR COMPANY TRAINING

DIAGNOSIS—CLUTCH AND BAND OPERATION

There are three forward gear ratios and one reverse gear ratio in the earlier model Cruise-O-Matic. The forward gear ratios are: first gear 2.40:1, second gear 1.46:1, high gear 1.00:1; and reverse gear ratio is 2.00:1. These planetary gear ratios work with a combination torque converter and fluid coupling drive, which, at stall, can multiply engine torque about two times.

There are three forward gear ratios and one revese gear ratio in the new Cruise-O-Matic. The forward gear ratios are: first gear 2.46:1, second gear 1.46:1, and high gear 1.00:1; and reverse gear ratio is 2.20:1. These planetary gear ratios work with a combination torque converter and fluid coupling, which, at stall, can multiply engine torque about two times.

The similarity between these transmissions does not end here. They have exactly the same number and kind of clutches (multiple disc and one-way), and exactly the same number and kind of bands.

Although the two gear trains are entirely different, the clutch and band operation is identical, provided that we give the earlier Cruise-O-Matic clutches and bands a truly functional name. Their names as we know them are location names rather than functional names.

The front clutch in the earlier Cruise-O-Matic does exactly the same things that the forward clutch in the new Cruise-O-Matic does. In the earlier Cruise-O-Matic, the front clutch is in front of the rear clutch. In the new Cruise-O-Matic, the forward (forward here refers to forward gears as opposed to reverse gear) clutch is located behind the reverse and high clutch. Having dropped all reference to location in the main case, we can say both transmissions have a forward clutch and the following statements apply to both transmissions.

1. This clutch is applied in all forward gears.
2. This clutch must release before the car can back up.
3. This clutch must release or the transmission is actually in first gear D1 with the selector lever in N.

The front band in the earlier Cruise-O-Matic and the intermediate band in the new Cruise-O-Matic function exactly alike.

1. This band is applied in second (intermediate) gear.
2. This band is applied in second gear D2.
3. When this band and the forward clutch are firmly applied, the car cannot roll backward.

The same kind of "run down" can be made on the rear clutch versus the reverse and high clutch, and on the rear band versus the low and reverse band.

If we keep in mind the operation rather than the location of the clutches and bands in the two transmissions, there is a large "carry-over" from the earlier Cruise-O-Matic.

CRUISE-O-MATIC CLUTCH AND BAND APPLICATION CHART

GEAR	1958 - 1965 MODEL	C 4 MODEL
FIRST GEAR D-1	FRONT CLUTCH & ONE-WAY CLUTCH	FORWARD CLUTCH & ONE-WAY CLUTCH
SECOND GEAR	FRONT CLUTCH & FRONT BAND	FORWARD CLUTCH & INTERMEDIATE BAND
HIGH GEAR	FRONT CLUTCH & REAR CLUTCH	FORWARD CLUTCH & REVERSE AND HIGH CLUTCH
REVERSE	REAR CLUTCH & REAR BAND	REVERSE AND HIGH CLUTCH & LOW AND REVERSE BAND
FIRST GEAR L	FRONT CLUTCH & REAR BAND	FORWARD CLUTCH & LOW AND REVERSE BAND

SERVICE FORD MOTOR COMPANY TRAINING