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AUTOMOTIVE DIESEL MAINTENANCE 2. UNIT VII, AUTOMATIC TRANSMISSIONS--ALLISON, TORQUMATIC SERIES 5960 AND 6060 (PART I).

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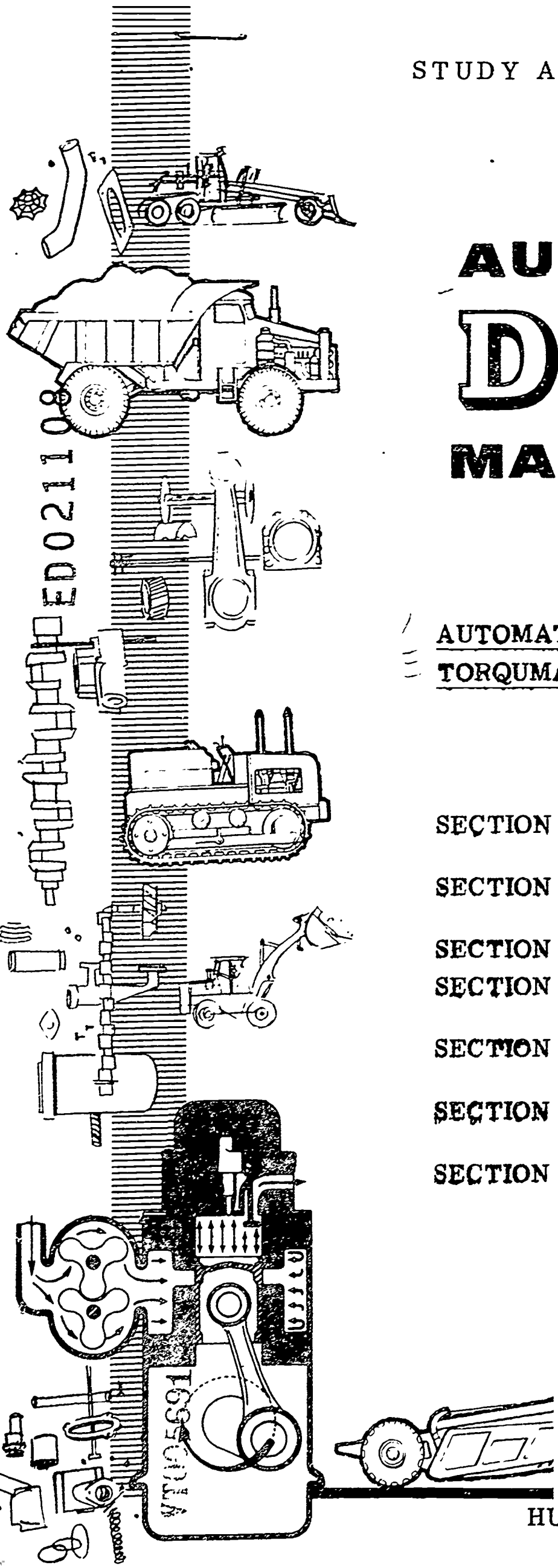
DESCRIPTORS- *STUDY GUIDES, *TEACHING GUIDES, *TRADE AND INDUSTRIAL EDUCATION, *AUTO MECHANICS (OCCUPATION), *EQUIPMENT MAINTENANCE, DIESEL ENGINES, ADULT VOCATIONAL EDUCATION, TRANSPARENCIES, PROGRAMED MATERIALS, INDIVIDUAL INSTRUCTION, INSTRUCTIONAL FILMS, MOTOR VEHICLES, KINETICS, PROGRAMED INSTRUCTION,

THIS MODULE OF A 25-MODULE COURSE IS DESIGNED TO DEVELOP AN UNDERSTANDING OF THE OPERATION AND MAINTENANCE OF SPECIFIC MODELS OF AUTOMATIC TRANSMISSIONS USED ON DIESEL POWERED VEHICLES. TOPICS ARE (1) GENERAL SPECIFICATION DATA, (2) OPTIONS FOR VARIOUS APPLICATIONS, (3) ROAD TEST INSTRUCTIONS, (4) IDENTIFICATION AND SPECIFICATION DATA, (5) ALLISON TC-500 SERIES CONVERTER, (6) CONVERTER HYDRAULIC SYSTEM, AND (7) MAINTAINING THE CONVERTER. THE MODULE CONSISTS OF AN INSTRUCTOR'S GUIDE, TRANSPARENCIES, AND TRAINEE TEXT MATERIAL. SEE VT 005 685 FOR FURTHER INFORMATION. MODULES IN THIS SERIES ARE AVAILABLE AS VT 005 685-VT 005 709. MODULES FOR "AUTOMOTIVE DIESEL MAINTENANCE 1" ARE AVAILABLE AS VT 005 655 - VT 005 684. THE 2-YEAR PROGRAM OUTLINE FOR "AUTOMOTIVE DIESEL MAINTENANCE 1 AND 2" IS AVAILABLE AS VT 006 006. THE TEXT MATERIAL AND TRANSPARENCIES MAY BE RENTED (FOR $1.75 PER WEEK) OR PURCHASED FROM THE HUMAN ENGINEERING INSTITUTE, HEADQUARTERS AND DEVELOPMENT CENTER, 2341 CARNEGIE AVENUE, CLEVELAND, OHIO 44115. (HC)



STUDY AND READING MATERIALS

AUTOMOTIVE DIESEL MAINTENANCE 2

AUTOMATIC TRANSMISSION -- ALLISON TORQUMATIC SERIES 5960 AND 6060 (PART I)

UNIT VII

SECTION A	GENERAL SPECIFICATION DATA
SECTION B	OPTIONS FOR VARIOUS APPLICATIONS
SECTION C	ROAD TEST INSTRUCTIONS
SECTION D	IDENTIFICATION AND SPECIFICATION DATA
SECTION E	ALLISON TC-500 SERIES CONVERTER
SECTION F	CONVERTER HYDRAULIC SYSTEM
SECTION G	MAINTAINING THE CONVERTER

AM 2-7
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U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
OFFICE OF EDUCATION

HUMAN ENGINEERING INSTITUTE

This is the first in a series of four units that will discuss specific models of the Allison Torqmatic transmission. In addition to the two models mentioned in the title of this unit, there will be coverage of the dual path, DP8860 model. This transmission is very similar to the other two, except that it will handle more horsepower and is used in larger and heavier equipment.

SECTION A -- GENERAL SPECIFICATION DATA

CAPACITIES AND OPTIONS -- The DP8860 is designed for very heavy duty operations (100 tons plus), and is capable of handling up to 800 horsepower engine input. The 5060 transmission, also designed for heavy duty equipment, handles up to 600 horsepower. The 5960 is designed for operation with engines up to 530 horsepower.

Each of these transmissions may have optional features such as remote engine mounting, Torqmatic retarder, transfer case (drop box), parking brake, power takeoff drive, or special converter lockup control (eliminating lockup in the first and reverse ranges). Various output flanges are also available.

MODEL DESIGNATION -- Each prefix letter and number in the model designation of the Allison transmission has a particular meaning in describing it.

For example: CLBT6060 is:

C - Converter
L - Lockup clutch
B - Torqmatic retarder
T - Transmission
6 - Type of converter
0 - Transmission capacity (HP)
6 - Number of forward speeds
0 - Model change

The DP stands for dual path, which will be explained later.

CONSTRUCTION FEATURES -- All three series (5960, 6060 and 8860) combine a Torqmatic converter with planetary gearing, with six ranges forward and one reverse. Range selection is manual, but lockup occurs automatically in all ranges. In the standard transmissions, lockup occurs in all ranges. However, an optional lockup valve body, which prevents lockup from occurring in low and reverse ranges, is available.

Packaged Design -- The torqmatic converter, planetary gearing, clutches retarder, oil supply and hydraulic control system are all contained in one compact package. This arrangement simplifies mounting and allows for easy removal.

Speedometer drive -- All three models have a 5/32 heavy-duty regular type drive. On straight-through models, the drive ratio is 0. 5:1. The transfer case models and the DP8860 have a ratio of 1:1.

OIL FILTERS -- The dual oil filters (see Figure 1) may be mounted directly on the transmission, or they may be remote mounted. The filter is equipped with a filter contamination signal warning switch.

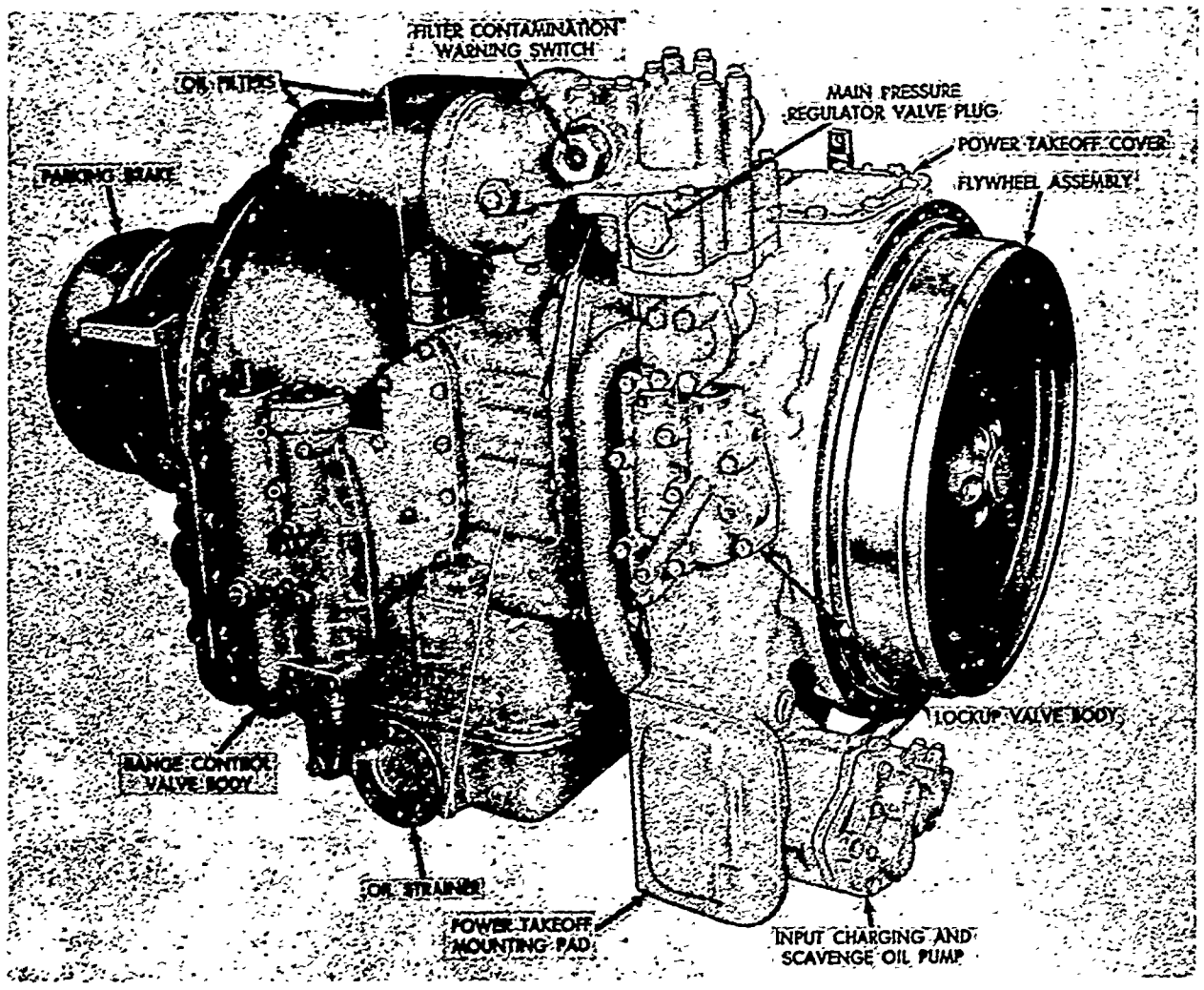

Fig. 1 Model CLBT6060 direct engine mount - right front view

SECTION B -- OPTIONS FOR VARIOUS APPLICATIONS

REMOTE MOUNTING -- All three transmissions (5960, 6060 and 8860) may be directly mounted on the engine (Figure 1) or remote mounted (Figure 2). Remote mounted versions have a flange on the input end. input end.

POWER TAKEOFF -- Each model may be equipped with a heavy-duty power takeoff at either the top or lower right side of the converter housing (viewed from the output end of the transmission) (see Figure 1). The top takeoff operates at a ratio of 1.21 x engine speed, while the side is 1:00 x engine speed.

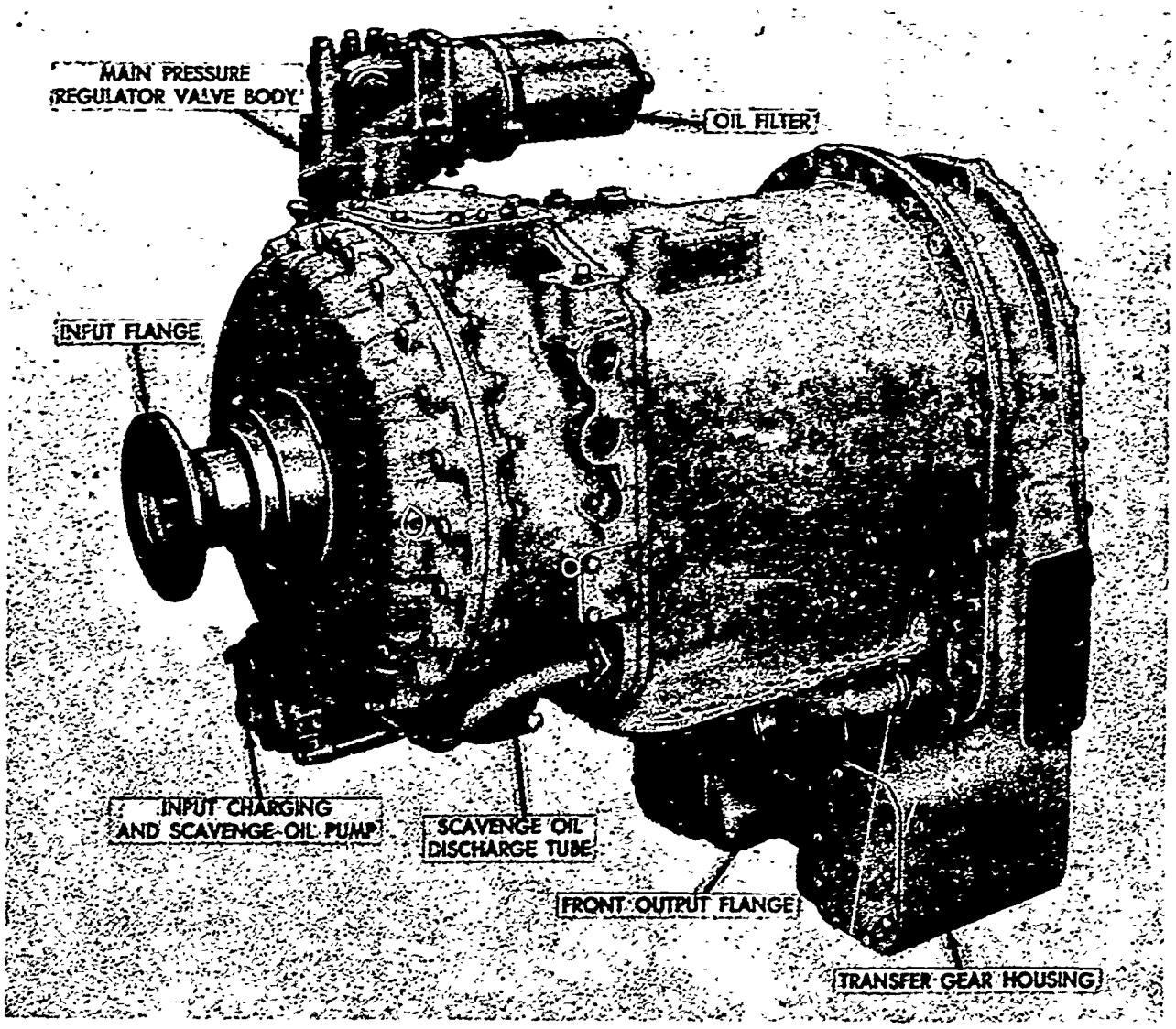

Fig. 2 Transmissions with remote mount and transfer gears - left front view

The purpose of a power takeoff (PTO) assembly is to supply power from the transmission countershaft for the operation of the hydraulic system oil pump.

TRANSFER CASE -- Drive may be straight through, with the output drive flange at the rear (see Figure 3); or through a transfer gear case (drop box) having output shaft located 18 1/2 inches directly below the transmission center line (see Figure 2).

Transfer case models may have the output flange facing either toward the front or the rear of the transmission, but not both.

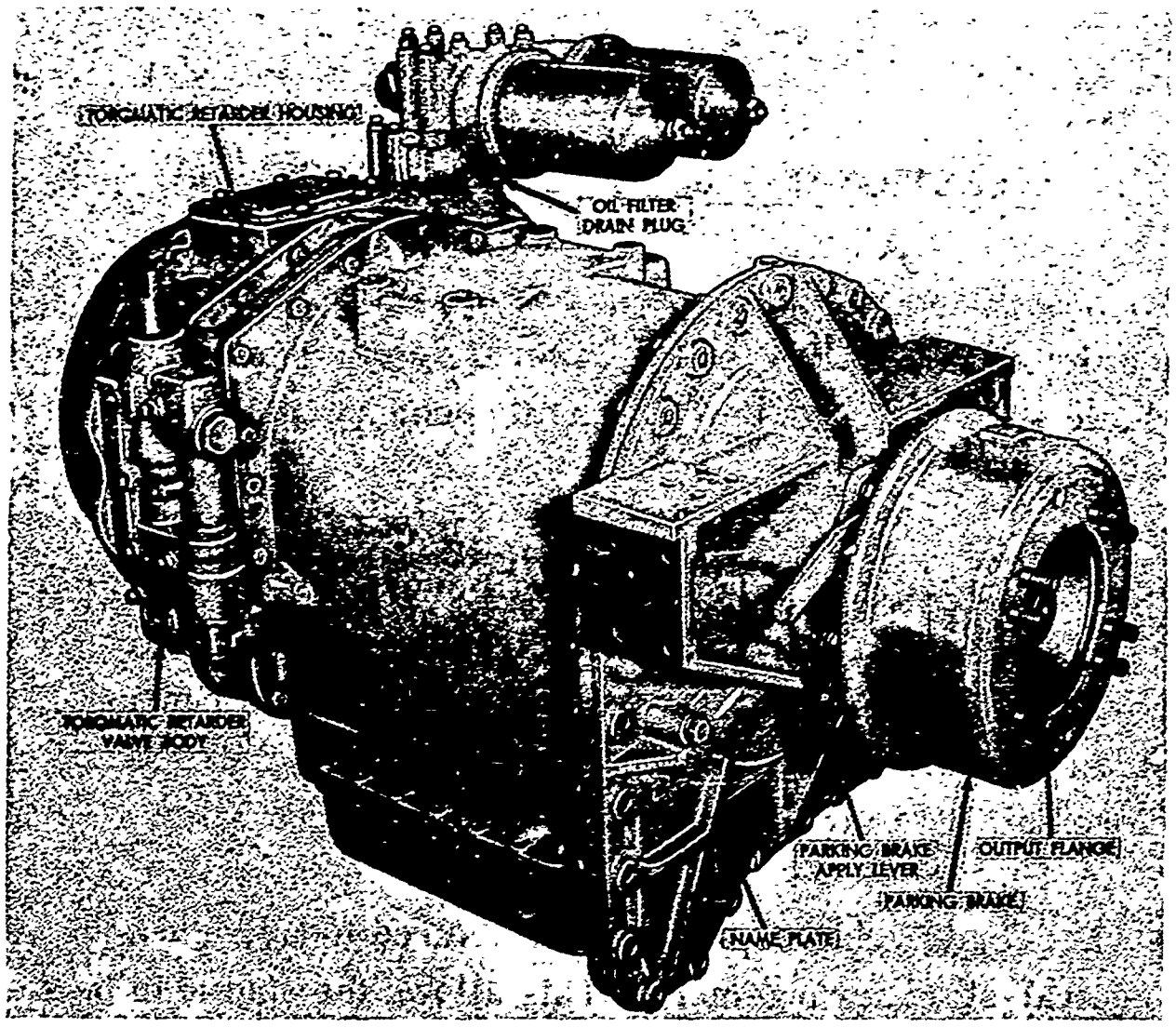

Fig. 3 Transmission, direct engine mount - left rear view

PARKING BRAKE -- Provision is made on the straight-through model transmission (5960/6060) for installing a 12 x 5 inch parking brake (see Figure 3). On the DP8860, a 17 1/4 inch diameter by 4 inches wide, 2 shoe, expanding-type parking brake is available on all models.

RETARDER -- The retarder is a device which, when charged with oil, helps to check the speed of the vehicle. The retarder makes available continuous downhill braking that is up to six times as effective as engine braking (see Figure 3). More will be said about this feature in later units.

LOCKUP VALVE BODY -- A special lockup control valve body can be installed on these transmissions which prevent lockup occurring in low and reverse ranges where it is desirable, such as in a scraper operation.

SECTION C -- ROAD TEST INSTRUCTIONS

It is possible to upshift or downshift these transmissions at wide-open throttle, regardless of load. However, a downshift must not be made if vehicle speed exceeds the maximum speed normally attained in the next lower range.

Downshifting at excessive speeds will overspeed the power train components. CAUTION: Shift the transmission to neutral before starting the engine or when vehicle is parked and engine is running. Also, when vehicle is moving in either a forward or reverse direction, stop vehicle before shifting to the opposite direction.

NOTE: Many vehicles being manufactured today, are equipped with a neutral-start arrangement. This allows the engine to be started only when the transmission is in neutral.

To move the vehicle, shift the manual selector control to the range desired and depress the accelerator.

TEMPERATURES, PRESSURES -- When road testing the vehicle, watch for any deviation from normal readings. If the converter-out oil temperature rises above 250 F, under normal operating conditions, stop the vehicle immediately and determine the cause. If no external oil leaks are visible, shift the transmission to neutral and run the engine at 1000 to 1200 rpm. The temperature should drop rapidly to the engine water temperature in two or three minutes. If the temperature does not drop, trouble is indicated. The cause of the trouble should be determined before further operation of the vehicle. Troubleshooting information will be shown in later units.

If operating under load on a hill, and the converter-out oil temperature rises above 250 F, downshift the transmission. If the high temperature persists, the transmission must be checked out.

RETARDER OPERATION -- The retarder, if applied, will function in any range. The range position which will give the most effective retarding is dependent upon the load and grade. In many operations, the retarder will be used most in second and third range. Shifting must not be done while the retarder is in operation. During prolonged use of the retarder, the converter-out temperature should not exceed 250 F.

SECTION D -- IDENTIFICATION AND SPECIFICATION DATA

Because of the many differences in transmissions and the number of options available, in addition to the serial number there is a transmission name plate, shown in Figure 4. The name plate includes an assembly part number which is located on the left, bottom side (viewed from the output end) of the output drive cover housing (see Figure 3). This part number should always be referenced when ordering parts etc.

SPECIFICATIONS, DATA, TORQUE RATIOS -- The following specifications and data table refers to all models of the 5960, 6060 andDP8860 series transmissions. Where differences between the three transmissions occur, they will be mentioned.

Fig. 4 Transmission name plate

Table I Specifications and data

ITEM		DESCRIPTION
Mounting	Direct:	Flywheel housing - SAE 1 (DP8860 SAEO), wet (21 bolt holes equally spaced on the basis of a 24 bolt circle); 2 mounting pads at rear
	REMOTE:	trunnion mounting at front; 2 mounting pads at rear

Input rating	Model 5960	Model 6060	Model 8860
Speed:	2500 rpm max	2100 rpm max	2100 rpm max
Torque:	1200 lb-ft max	1400 lb-ft max	2200 lb-ft max

Horsepower Range ---------- Model 5960 - up to 530 ghp
Model 6060 - up to 600 ghp
Model 8860 - up to 800 nhp

Rotation (viewed from input end)---------- Input - clockwise
Output - clockwise

Converter:
type---------- single-stage, 3 element, polyphase
multiplication ratio---------- Model 5960 -TC 590, 2.56:1
Model 6060 -TC 580, 2.16:1
Model 8860 -TC 840, 2.21:1

Lockup clutch---------- automatic in all gears, or automatic in all gears but first, second and reverse

Gear data---------- constant mesh, spur type, planetary

Gear ratios:	Models 5960/6060 Ratio	Model 8860 Ratio
first gear	4:00;1	4.24:1
second gear	2.68:1	2.34:1
third gear	2.01:1	1.70:1

Table I Specifications and data (continued)

ITEM	DESCRIPTION	
Gear ratios (continued)	Models 5960/6060 Ratio	Model 8860 Ratio
fourth gear	1.35:1	1.31:1
fifth gear	1.00:1	1.00:1
sixth gear	0.67:1	0.73:1
reverse gear	5.12:1	5.75:1
transfer gear	1:1	----
Range clutches	Multidisk, hydraulic-actuated, spring-released, oil-cooled, self adjusting	
Sump	Integral on both straight-through and transfer gear housing models	
Pumps	Input pressure and scavenge oil pump; positive displacement, spur gear type; push start oil pump; (straight through models only) positive displacement, internal external gear type	
Oil filter	Two parallel, full-flow, cartridge-type, with filter contamination signal warning switch, mounted on transmission (remote-mount optional)	
Oil type (above -10F)	Hydraulic transmission fluid type C-1 (limited to oils of SAE 10W viscosity)	
(-10F to -25F)	Automatic transmission fluid, type A (suffix A identification)	
(below -25F)	Hydraulic transmission fluid, type C-1 or automatic transmission fluid, type A - (suffix A identification)	

(NOTE: Above oil types are only recommended; many organizations use SAE 10W year-round)

Table I Specifications and data (continued)

ITEM	DESCRIPTION
Main pressure - (model 5960 and 6060)	
1st reverse	1500 rpm input speed, output stalled - 210 to 250 psi
1st reverse	Full throttle, normal operating output speed range -- 210 to 265 psi
2,3,4,5,6	1500 rpm input speed, output stalled 140 to 155 psi
2,3,4,5,6	Full throttle, normal operating output speed range --140 to 170 psi
Main pressure (full throttle stall) - (Model 8860)	
Main (first, second, reverse)	190 psi min 230 psi max
(third, fourth, fifth, sixth)	140 psi min 155 psi max
lubrication	50 psi
Converter-out oil pressure	Full throttle, normal operating output shaft speed range -- 30 to 65 psi
Lube pressure (models 5960/6060)	
(CLT, all driving ranges)	1500 rpm input speed, output stalled - 20 psi min. Neutral, 1500 rpm input speed, output stalled - 20 psi min. Neutral, full throttle, output stalled - 30 psi max.
Retarder (models 5960/6060)	Absorption capacity: 1200 lb-ft torque at 1100 rpm (CLBT models only)
Retarder (model 8860)	
type	Vaned rotor between fixed vanes
capacity	3000 lb-ft at 2300 rpm

Table I Specifications and data (continued)

ITEM	DESCRIPTION
Oil capacity (models 5960/6060) (Straight-through model	Initial fill: approx. 18 gal, plus cooling circuit Refill: 14 1/2 gallons
(drop box model)	Initial fill: approx. 13 gal. plus cooling circuit Refill: 10 gallons
Oil capacity (model DP8860)	Initial fill: 19 gal. plus external circuit Refill: 17 gallons

SECTION E -- ALLISON TC-500 SERIES CONVERTER

Since the converters for the three transmissions being discussed are basically the same, this section will review the principles and operation of the TC-500 series used on the 5960 and 6060 model transmissions.

Figure 5 shows a cutaway view of the TC-500 converter. This converter performs two functions: It increases the torque or twisting force which the engine delivers, and it acts as a fluid coupling between the engine and planetary gearing when an increase or multiplication of torque is no longer necessary.

1-Flywheel
2-Ring Gear
3-Flexible Disc Assembly
4-Output Shaft
5-Split Race Bearing
6-Turbine
7-First Stator
8-Converter Pump
9-Second Stator
10-Oil Seal
11-Converter Housing
12-Ground Sleeve
13-Bearing Retainer
14-Ball Bearing
15-Oil Seal
16-Output Flange
17-Charging Pump Drive Gear
18-Idler Gear Shaft
19-Idler Gear & Bearing
20-Charging Pump Gear & Shaft
21-Charging Pump Body
22-Hook Type Seal Ring
23-Charging Pump Driving Gear
24-Driven Gear Shaft
25-Driven Gear & Bearing
26-Charging Pump Cover
27-Clutch Pressure Regulating Valve
28-Regulating Valve Spring
29-Shims
30-Plug
31-Converter Pump Hub

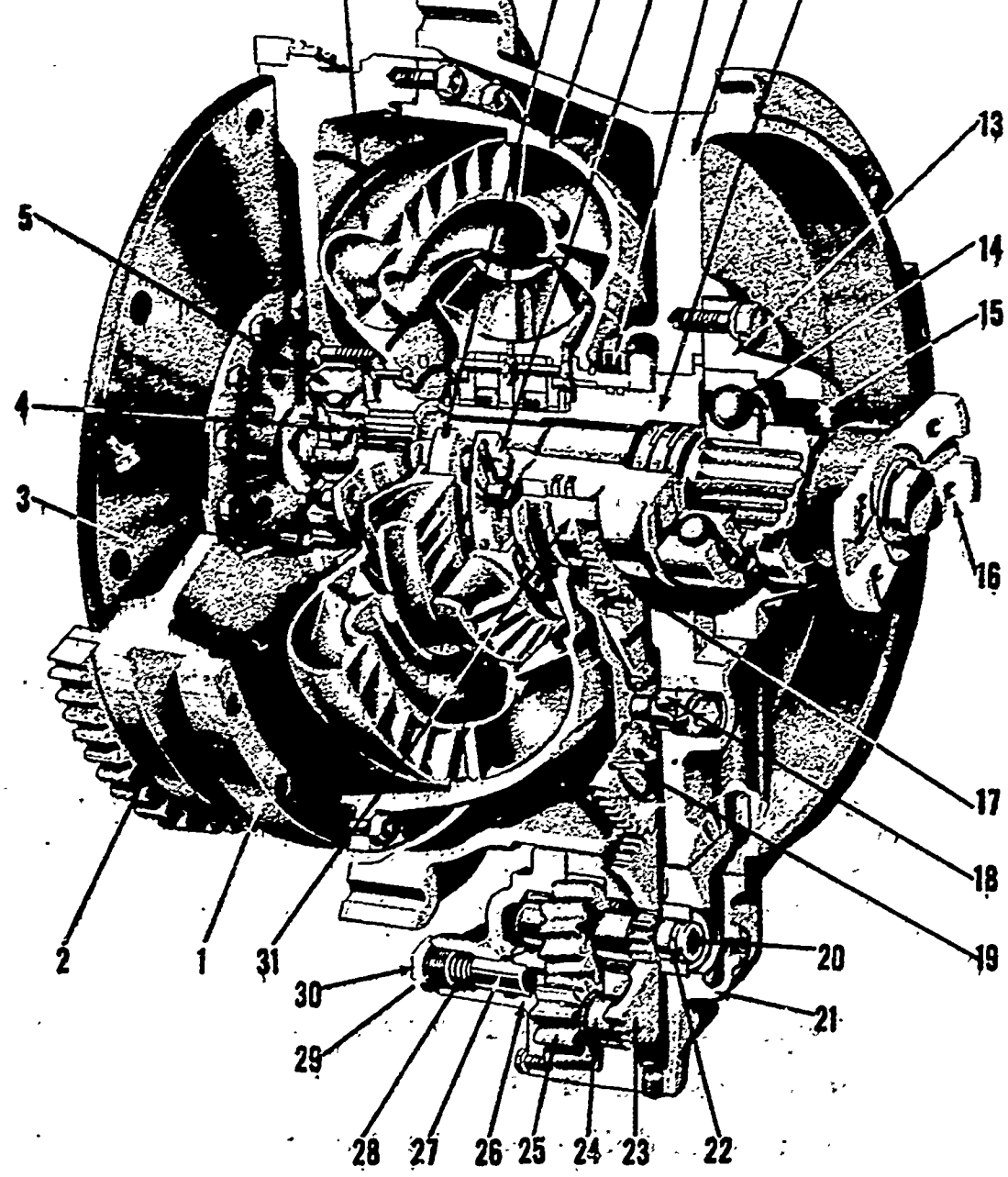

Fig. 5 Cutaway view of a torqmatic converter

In Figure 5, the four major elements of the converter are the converter pump (6), the turbine (5), the first stator (32) and the second stator (31). The converter pump is bolted to and driven by the engine flywheel (3). Thus, the converter pump revolves at the same speed as the engine crankshaft. The turbine is splined to the converter output shaft (19). The turbine is free to rotate in the oil tight housing formed by the converter pump and the flywheel. The first and second stators ride on a roller race (8), splined to the converter ground sleeve (14), between the converter pump and the turbine. These stators are free to rotate in the direction of rotation of the converter pump but will lock up immediately when backward pressure is applied.

During operation, the area between the converter pump (6) and the turbine (5) is filled with oil. To fully understand the operating principles of the converter, the flow of oil within this area must be studied.

When the engine is running, the converter pump (6) is turning at the same speed as the engine crankshaft. Due to the design of the vanes cast into the converter pump, oil is directed from the converter pump to the turbine (5). At the turbine, the oil is caught in the turbine vanes in such a manner as to impart mechanical rotation to the turbine in the same direction as the pump.

To gain the maximum force from the oil being delivered by the converter pump (6), the turbine (5) changes the DIRECTION of this oil flow to the maximum degree. The oil flows from the outer circumference of the turbine to its center and leaves the turbine traveling in the opposite direction to the rotation of the pump and turbine. At low turbine speed, that is when the turbine is rotating slower than the converter pump, such as when starting to move the vehicle or in heavy pulling, the turbine offers a resistance to turning. The oil slides through the vanes and leaves the turbine with a greater force than that with which it entered. Unless the direction of oil flow is changed, the oil flowing from the turbine will work against the oil flowing from the converter pump.

It is during this phase of operation that the stators (31 and 32) are used. As explained on the previous page, the stators are free to rotate in the direction of rotation of the pump and turbine, but lock when backward pressure is applied. The oil coming from the turbine (5) exerts a backward pressure on the stators and locks them in place. The oil then flows through the stators, which change its direction of flow and direct it into the converter pump hub.

At the converter pump (6), the force of this oil is added to the force of the oil which is flowing from the converter pump back to the turbine (5). This, then, is the key to torque multiplication. The combination of the two forces is greater than the converter pump can produce; therefore, the oil strikes the turbine with a greater force than before. In other words, the torque being produced by the engine and transferred through the converter pump is multiplied by the redirected turbine oil flow.

As the unit moves over the terrain, the speed of the turbine (5) approaches that of the converter pump (6). When the turbine speeds up, the oil leaving the turbine loses its force. With a sufficient drop in force, the oil no longer acts upon the front face of the first stator (32) vanes but is thrown partly against the back face. The force against the back face causes the first stator to free-wheel in the same direction as the turbine is turning. With a further increase in turbine speed in relation to pump speed, the second stator (31) is acted upon in the same manner and also begins to free-wheel. From that point on, torque multiplication stops and the converter acts as a fluid coupling.

In addition to the converter elements, a converter charging pump is bolted to the converter housing. This pump furnishes high pressure oil for converter cooling and for operation of the transmission planetary gearing pistons.

The pump is driven from the charging pump drive gear (13) keyed to the converter pump hub (11), through the idler gear (20) and the pump drive gear (24). Whenever the engine is turning over, the pump is being driven; therefore, a constant supply of oil is being fed to the converter and to the transmission control valve at all times.

SECTION F -- CONVERTER HYDRAULIC SYSTEM

The hydraulic system of the converter is combined with the transmission with which it is used. The transmission sump serves as the oil reservoir for both the converter and the transmission. Incorporated in the transmission is a breather and an oil level check plug.

The flow of oil in the system is from the transmission sump through the converter charging pump to the converter and back to the sump. Incorporated in the circuit is: an oil filter, an oil cooler, one or more pressure regulating valves, and pressure temperature gages. A drain line from the converter to the oil reservoir must be included.

The charging pump is mounted on the converter housing and is driven by the hub of the converter pump. It provides charging pressure and a cooling flow of oil through the internal passageways of the converter. Whenever the engine runs, the pump is driven. The charging pump also provides pressure to the transmission clutches through an external opening in the pump body.

A pressure regulating valve within the pump cover controls the pressure to the transmission clutches. Oil from the pump is diverted to the transmission clutches until the normal clutch pressure is reached. The valve then opens to permit oil to flow to the converter. An excess of oil pressure in the converter will cause bypassing of surplus oil to the suction side of the charging pump.

Incoming oil from the charging pump flows through internal passageways in the converter housing and through the ground sleeve. It then encounters the converter elements between the second stator and the converter pump. The oil leaves the converter elements between the first stator and the turbine; flows inside the ground sleeve, along the output shaft and out through a passageway in the converter housing to the sump.

The majority of moving parts in the converter are lubricated by the oil which goes through the normal work cycle. A small quantity of oil seeps by the hook-type seal rings on the output shaft and similar rings on the ground sleeve. This oil lubricates the rear bearing on the output shaft and the gear train which drives the oil pump. Gravity drains this oil from the housing to the oil reservoir through a line from the rear of the converter housing; this line should always be located below the centerline of the converter and must be installed.

SECTION G -- MAINTAINING THE CONVERTER

Because the converter is used with the transmission, the converter must be considered part of a system involving both units. Periodic preventive maintenance on one should be performed to the other as well.

Check the oil level at the transmission sump location on the transmission daily. Check the converter generally for leaks at the same time. Oil change intervals and using the correct type of oil should be strictly adhered to. Converter oil temperature and pressure checks should be regularly performed.

The oil which has been retained between the pump and turbine will flow through the drain hole, into the converter housing, and down into the engine flywheel housing. Cummins engines have an unplugged hole in the bottom of the flywheel housing, through which this oil can drain. GM

engines have a pipe plug in the front of the flywheel housing at the bottom, which must be removed to drain the oil. Do not let this oil accumulate because it will build up high enough to work through the rear main bearing of the engine and into the crankcase.

Another potential source of trouble is oil leaking around the rear seal on the pump hub. Some leakage is desirable, but it should not exceed one pint per week. If the converter transmission unit seems to be using considerable oil while the engine seems to be making oil, check the pump hub seal. Excessive leakage around the seal causes this condition.

More will be covered about the troubleshooting and inspection of the converter transmission system in later units.

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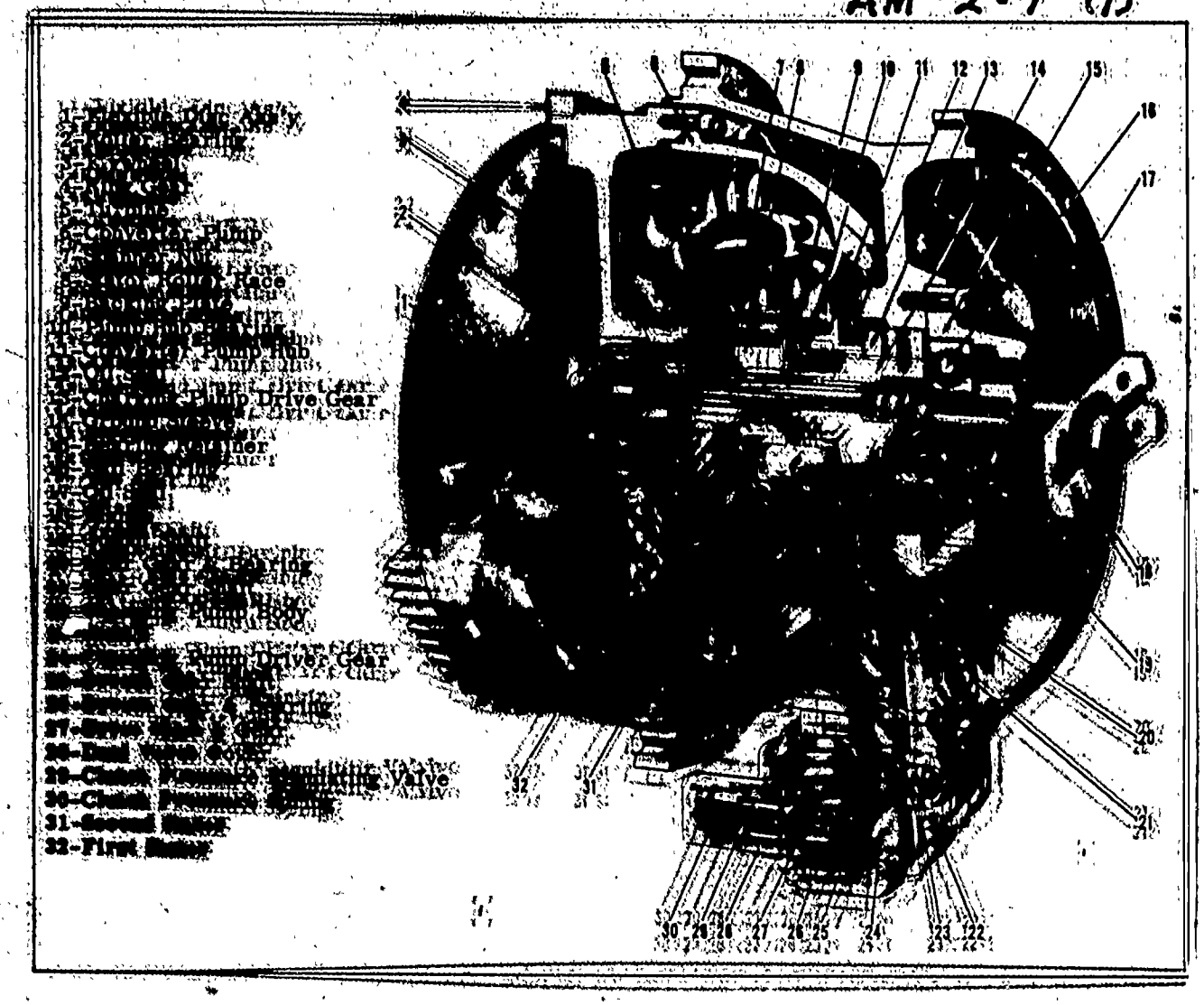

HUMAN
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2341 Carnegie Ave
Cleveland Ohio 44115

INSTRUCTOR'S GUIDE

Title: AUTOMATIC TRANSMISSIONS -- ALLISON TORQMATIC SERIES 5960 and 6060 (PART I)

AM 2-7
4/13/67

OBJECTIVES:

1. To introduce the student to specific models of the Allison transmission by covering the basic unit and options that are available.

2. To show what is necessary to check out a transmission for proper operation.

3. To explain the operation of a typical converter, the oil source, the oil flow, and how the converter and transmission are maintained.

LEARNING AIDS: (suggested)

VU CELL: AM 2-7 (1) (Cutaway view of a Torqmatic Converter)

MODELS: Any components or parts of a transmission that can be brought to class would be helpful for discussion purposes.

Contact your local Allison Distributor for any cutaways or films he may have. There has been excellent cooperation from GM on previous units.

QUESTIONS FOR DISCUSSION AND GROUP PARTICIPATION:

1. What is meant by a transmission having a 'transfer box'?
2. What do the letters/numbers CLBT6060, stand for?
3. What do the figures, 0. 5:1 indicate?
4. Why would a PTO be needed on a transmission?
5. Are there two PTO's on the transmissions discussed?
6. What is the purpose of having a 'retarder' on these types of transmissions?
7. In what type of an operation would it not be advisable to have 'lockup' in all ranges?

QUESTIONS (continued):

8. What is the maximum temperature that the oil in a transmission should not exceed?

9. What are the four main components of the converter?

10. At what speed does the converter pump rotate?

11. Will the stator(s) turn in both directions? Explain.

12. How is the converter charging pump driven?