ABSTRACT: A quick exchange engine assembly comprising an engine, a transmission, a radiator and a forward cross member of the engine frame which are so connected together that they form a self-supporting unit which is designed to be mounted directly on the side rails of the engine frame thereby eliminating the need of a subframe or tray for the unit.
QUICK EXCHANGE ENGINE ASSEMBLY

BODY OF THE SPECIFICATION

The invention will be explained in connection with a quick exchange power assembly for a highway tractor, but the invention has application to any vehicle wherein it is desirable to effect quick exchange of the power unit.

At the present time, it takes anywhere from 10 to 20 man-hours to make an engine change in a highway tractor. The time required to repair the engine or associated components can tie up a vehicle for many additional hours. At the present time, in removing an engine, it is the common practice to drain the radiator and disconnect it from the engine, since the radiator is independently and fixedly mounted on the frame or chassis of the vehicle. It is also common to find that the vehicle frame has a cross member extending above the transmission, making it necessary to remove the transmission prior to the removal of the engine. It is also necessary to disconnect one or more of the universal joints in the drive line, which task is not only time-consuming but also exposes the needle bearings of the U-joints to contamination. Time is also consumed in dismantling part of the exhaust system to enable the engine to be removed, and additional time is usually consumed in disconnecting or disconnecting part of the air intake system. Further time is consumed in individually disconnecting the various hydraulic, oil, fuel and similar lines and in disconnecting the many electrical conductors which lead from the engine to various other parts of the vehicle.

It is a main object of the present invention to provide a quick exchange power assembly so designed that, within a short time, the engine assembly can be removed from the chassis or frame and another engine assembly inserted in place so that the vehicle is ready for continued use. In trial runs it has been possible to change a complete engine power package of the present invention in less than one-half hour.

It is a further object of the invention to provide a quick exchange power assembly which when removed is in such condition that it can be quickly and readily mounted in a test stand and connected to a dynometer and operated under test conditions to better determine operating difficulties and defects.

Various other objects of the invention will be apparent from the following description taken in connection with the accompanying drawings wherein:

FIG. 1 is a side view of a typical highway tractor having a tilt cab shown in full lines in its operative position and in broken lines in tilted condition; FIG. 2 is a view similar to FIG. 1 showing the cab in full lines in tilted condition, and showing the quick exchange power assembly as having been disconnected from and hoisted above the vehicle frame; FIG. 2A is a fragmentary view of part of the exhaust system; FIG. 3 is a plan view of the quick exchange power assembly mounted in a test stand; FIG. 4 is a vertical cross-sectional view through the engine frame at the front of the engine; FIG. 5 is a vertical sectional view taken along lines 5-5 of FIG. 6; FIG. 6 is a vertical sectional view taken through one of the rear mounting brackets for the engine assembly; FIG. 7 is a vertical sectional view taken along line 7-7 of FIG. 6; FIG. 8 is an enlarged vertical sectional view taken along line 8-8 of FIG. 2; FIG. 9 is an enlarged vertical sectional view taken along line 9-9 of FIG. 8; FIG. 10 is a side elevational view of the cluster type quick disconnect device for the fluid and certain of the electrical lines; FIG. 11 is a vertical sectional view taken along line 11-11 of FIG. 10. FIG. 1 shows a highway tractor having a chassis or frame 11 supported by wheels 13. A cab 15 is mounted on the frame 11 for forward tilting movement about pivots 17 from the solid line position shown in FIG. 1 to the dotted line position. The cab overflies a quick exchange engine assembly of the present invention. This assembly includes an engine 19 (FIG. 2), a clutch, and a transmission 31 located rearwardly of the flywheel housing 32. A drive line 33 extends rearwardly from the transmission and has a quick disconnect flange unit 35 (FIGS. 2, 8 and 9) about which more will be presently said. The engine assembly also includes a radiator 41 which is disposed forwardly of the engine and which is connected by the usual hoses to cooling water passages in the engine.

The radiator is mounted in place by a pair of mounting end plates 43 which are rigidly secured, such as by bolts 45 to the radiator. The plates are also rigidly secured such as by welds 47 (FIGS. 2 and 4) to the end portions of a frame cross member 49 which is commonly referred to as a "trunnion" in the art. As shown in FIG. 4, the front end 51 of the crankshaft of the engine is journaled by bearing means 53 on the central portion of the trunnion cross member 49. The bearing means 53 has an elastomer ring to resiliently support the crankshaft. When the engine assembly is in place on the frame, the end plates 43 are secured (in a manner to be presently described) in rigid relation to the frame side rails 55 (FIG. 4) by bolts 57. It is evident that when the engine assembly is in place, the engine 19 is movably mounted on the vehicle frame as it should be, yet the radiator 41 is rigidly secured to the engine frame, as it should be. It should be pointed out that there are cut outs at 59 in the channel shaped frame side rails 55 to provide clearance for the mounting plates 43.

In FIG. 2, the engine assembly is shown as being suspended from a T-bar 71 which in turn is suspended by a chain 73 from a crane or hoist, or equivalent apparatus. The rear end of the shank portion of the T-bar is connected by a hook chain 75 to lift bracket 77 provided on the engine, whereas the lateral ends of the head 79 on the T-bar are each supplied by a hook chain 81, each hook fitting on appropriate opening 83 formed in the associated mounting plate 43.

When the engine assembly is being lowered into place on the frame, laterally projecting ears 91 (FIGS. 2 and 7) on the flywheel housing 32 slidably fit down into guides 93 provided by brackets 95. The latter are secured by bolts 97 to the associated frame side rails 55. The ears are yieldably held in place by bolts 99 which pass through resilient biscuits 101, then through the ears, then through wear pads 103 on shelf portions 105 of the brackets, and finally through captive nuts 107 carried by the shelf portions.

A stabilizing means is provided between the upper end of the radiator 41 and the engine 19 to stabilize the radiator relative to the engine during removal of the engine assembly. This means comprises a link 109 which is movably (resiliently) connected at its opposite ends to the radiator and engine. Thus, the link effects a stabilizing influence when the engine assembly is removed, yet allows the engine to move relative to the radiator 41 when the engine assembly is mounted in place on the frame. When the engine assembly is removed from the vehicle, it may be mounted in a test stand 111 about which more will be presently said.

The exhaust system for the vehicle is best shown in FIGS. 1-3. The system shown is of the "breaking" type and includes an inner run 113 which is mounted on the engine and frame, and an outer run 115 which is shown as being mounted on the cab 15. If the system were nonbreaking, run 115 could be mounted on the frame 11 independently of the cab. When the cab is tilted forwardly, the exhaust system "breaks" at a coupling which includes an upstanding pipe section 117 on the outer end of the inner run 113 and a bell 119 on the lower end of the outer run 115. Frequently, the pipe section 117 is weldedly mounted on the truck frame by a spring arrangement 121. It is also standard to provide a bracket 123 to support the inner run on the engine 19.

The inner run 113 of the exhaust system has a quick disconnect coupling 131 in it between section 117 and the bracket 123 whereby the inner portion of the inner run 113 becomes a
part of the engine assembly, leaving the section 117 mounted on the frame 11. The coupling is of the Marman flange type and includes a Marman band clamping engage a pair of mating flanges, one on the inner end of the section 117 and the other on the outer end of the inner run portion.

The electric lines on the left hand side of the engine assembly and all of the fluid lines of the assembly are clustered at one point and disconnect device 150 for rapid breaking of said lines. The lower part of such device is shown in FIG. 2 while the entire device is shown in FIGS. 10 and 11. The device includes a lower channel section 151 and a mating upper section 153, the lower section having upstanding dowel pins 155 fitting in holes in the upper section to guide the upper section into proper engagement with the lower section. There is a clamp unit 157 at each end of the lower section to clamp the upper section down onto the lower section. Each clamp unit has an over center action and includes a ball portion 159 which is pulled downwardly upon elevation of the associated handle portion 161 to bear against a tang portion of the upper section. The tang portion is embraced by the ball portion in the locked position of the clamp unit.

The upper and lower sections carry opposed quick disconnect couplers of conventional form. For the fluid lines each coupler has a built in check means which are operable when the coupler sections are separated to block the line with which they are associated.

In the particular embodiment of the invention shown there is a gang type electrical quick disconnect coupler 162 to which all the left hand electrical conductors are led and which, when separated, interrupts the flow of current through all such conductors.

The fluid lines shown are merely illustrative. There may be more or less or different lines, but they would be disconnected or "broken" in the manner shown. There is a fuel supply line 163 having a coupler 164, and a fuel return line 165 having a coupler 167. There is also a compressor discharge line 169 and its coupler 171; a constant pressure air supply line 173 and its coupler 175; a bypass filter oil return line 177 and its coupler 179; a bypass filter oil supply 181 and its coupler 183; a shift selector air line 185 and its coupler 187; a filtered air (shift) line 189 and its coupler 191; and another shift selector air line 193 and its coupler 195. There is an oil gauge line (not shown) and a coupler (not shown) for it in the cluster type quick disconnect set 150.

The electrical conductors on the right hand side of the engine assembly, except for the head starter cables, are brought together to a single gang type quick disconnect device so that snapping the device apart "breaks" such conductors.

It was previously mentioned that there is a quick disconnect flange unit 35 in the drive line 33. This unit is best shown in FIGS. 8 and 9 and includes a flange 201 on the transmission output shaft, a mating flange 203 on the first U-joint half. Flange 203 has plural drive studs 205 fixedly secured thereto and snugly fitting into mating holes formed in the flange 201.

The flanges have tapered outside marginal portions so that a split Marman band 207, which fits over and around such marginal portions, cams them toward one another and holds the flanges in tight engagement.

To "break" the drive line, the band is loosened on one side so it can be removed, after which one of the flanges is axially moved away from the other (by way of a splined drive line joint) to separate the drive studs 205 from the flange 201.

**QUICK EXCHANGE OPERATION**

It may be assumed that the highway tractor has been driven into the repair shop and that an exchange of engine assemblies is desired. The cab 15 is tilted forward as shown in FIG. 2 whereas the following is done, but not necessarily in the sequence listed: (1) the clamp band of exhaust clamp 131 is loosened and removed whereby to free the inner portion of the run 113 for removal with the assembly; (2) the various linkages from the engine assembly to the remainder of the vehicle (such as the shift, clutch, transmission, and throttle linkages and the compression release cable) are "broken" or separated; (3) the drive line is "broken" at clamp 35; (4) the cluster device 150 is separated, the right hand gang electrical coupler is separated and the starter cables are detached; (5) the bolts 57 at plates 43 and the bolts 99 at ears 91 are removed. It is assumed that the brakes are operated by linkages or members associated with the vehicle frame and cab, but not the engine assembly, so that no work on such linkages or members need be done. Now the chain hooks 81 and 75 are connected to the engine assembly and the assembly lifted out of the frame 11 and lowered into the test stand 111 (or placed on other supporting means in accordance with the desires of the shop).

Now a replacement engine assembly is hoisted over the frame 11 and lowered into place. It is pointed out that the trunion end plates 43 have guide slots 301 (FIG. 2) formed therein to engage guide shafts or plugs 303 (FIG. 4) provided on guide plates 305 so that the engagement of such slots and plugs together with the guided engagement between the ears 91 and brackets 95 assume proper location of the replacement assembly on the vehicle frame 11.

Now a connecting procedure, the reverse from that outlined above, is carried out to mount the assembly in place and operatively connect it to the remainder of the vehicle. This can be readily accomplished, after which the cab is pivoted back to its operative position and the tractor is ready to be driven off for continued use.

It is important to the invention that the front cross trunnion member 49 be a part of the engine assembly and removed with it. Otherwise the engine would have to be disconnected from such member and also disconnected from the radiator, after the radiator has been drained. These steps would increase the replacement time, and also render the engine assembly imperborable for test stand use, unless the stand had a radiator of its own and time was spent in reconnecting and filling the radiator.

The second frame cross member (that is, the one next rearward of the front cross member) should be located rearward of the quick disconnect coupling 35 so that the engine assembly can be lifted directly upwardly after it is disconnected from the remainder of the vehicle. If the second cross member were to overlie the front of the transmission, rapid removal of the engine assembly would be impractical because the transmission would have to be disconnected from the engine. If the second cross member happens to overlie the flange unit 35 or the rear portion of the transmission, it may be possible to raise the front end of the engine assembly sufficiently so that ears 91 clear the bracket guides 93 and the trunion end plates 43 clear the guide plugs 303, and then to shift the assembly forwardly into the raised cab sufficiently to clear the assembly with respect to the second frame cross member. Thereafter the assembly could be moved rearwardly slightly and raised as before.

The guide plates 305, previously mentioned, are mounted on the frame side rails 55 by bolts 307. Spacers 309 are provided between the guide plates 305 and the rails to properly locate the inner faces of the guide plates relative to the outer faces of the trunion end plates 43. This is necessary because while the spacing between the outer faces of the guide rails is standard in the industry, the side rail thickness varies. By use of different thickness spacers 309, one engine assembly can be readily, properly mounted in tractor frames having side rails of different thicknesses.

The upper edges of the guide plates 305 are beveled at 311 (FIG. 4) to provide guide surfaces which can be engaged by the trunion end plates 43 when lowering an engine assembly into place, to cam the engine assembly inwardly to a central position between the side rails.

The guide plates 43 have inwardly bent lower flanges 315 upon which the trunion end plates 43 rest when an engine assembly is lowered onto the vehicle frame. These flanges are bent so that they dispose the engine assembly at the proper
angle to the vehicle frame. Different engines have different proper longitudinal angular relations to the same frame. By providing guide plates keyed to various engines, a vehicle frame can be readily adapted to support different engines. Thus the guide plates 305 may be considered as adapter guide plates.

Preferably the air intake system, numbered 401 in FIG. 2, is mounted solely on the engine 19 because with such construction the system need not be disconnected from the remainder of the vehicle upon removal of the engine assembly. Such system may be of the type having a forwardly directed air intake 403. This intake receives a portion of the air which passes through the grillwork (at the front of the cab) and flows rearwardly toward the engine assembly.

While the electrical and fluid lines are shown as being grouped at two places for quick disconnection, they could be grouped at a single place.

FIG. 3 shows that the test stand 111 may have an associated dynometer to which the drive line flange 201 may be connected. The stand has appropriate mounting portions to receive and mount the trunnion end plates 43 and the ears 91. An exhaust outlet is connected to the coupling flange of inner run 113. The stand has various fluid and electrical supplies with lines leading to a cluster coupler upper half, which can be easily coupled to the lower half 153 on the engine. The right side electrical gang device is connected up and the starter cables attached. Suitable controls are now connected to the throttle, clutch, transmission, and other (if any) mechanically actuated devices on the assembly. The assembly is now ready for testing.

An advantage of the engine assembly of the present invention is that it requires no subframe, being the trunnion cross member and its connection by the trunnion end plates 43 to the radiator, together with (1) the guided fit of such end plates with the adapter guide plates 305, and (2) the guided fit of the ears 91 with the frame 11, effectively constitute the engine assembly subframe mountable on the vehicle frame 11. It is contemplated that most or all of the mechanical linkages between the cab and engine assembly will have quick disconnect couplings incorporated therein to enable them to be readily separated or "broken." Removable pins or other elements could be used for such purpose.

It will be appreciated that more rapid removal of the engine assembly can be accomplished with the quick disconnect device 150 and the other quick disconnect devices described herein, because upon removal of said cross member the complete assembly could be supplied with the self-supporting engine assembly without the quick disconnect devices and still achieve more rapid engine replacement than is now possible. Furthermore, the engine assembly, when removed, would be suitable for test stand use.

Having described the invention in what is considered to be the preferred embodiment thereof, it is desired that it be understood that the invention is not to be limited other than by the provisions of the following claims.

We claim:

1. A quick exchange assembly mounted in a vehicle frame: said frame having spaced side rails connected by various cross members; said assembly including an engine unit, a transmission and a radiator connected together for removal as a unit; said assembly including a forward cross member, to which the radiator is secured;

2. A quick exchange engine assembly for mounting in a vehicle frame having spaced, generally parallel, side rails connected together by a front cross member and other cross members;

3. Said assembly including an engine unit and a transmission fixedly secured together;

4. Said assembly including a radiator forwardly of said engine unit;

5. Said assembly including a forwardly disposed cross member of the vehicle frame;

6. Means pivotally mounting said engine unit on the central portion of said forwardly disposed cross member to frame side rails of the vehicle frame;

7. Second detachable means on the rear portion of said assembly and completely separate from said first detachable means for detachable connection to the frame side rails of the vehicle frame, whereby said engine assembly can be disconnected from the frame side rails by detaching said first and second detachable means;

8. Said first and second detachable means having vertically extending guide means and guides complementary to the guide portions on side rails for guiding the cross member and the rear portion of said assembly to positions centered between the side rails as the assembly is lowered to its operative position.

9. An assembly as described in claim 2 wherein there is a link and means for movably connecting said link at its ends to the upper portion of said radiator and to said engine to stabilize the two relative to one another upon removal of the same.

10. An assembly as described in claim 2 wherein there is a cluster type quick disconnect device on said engine unit to which electrical and fluid lines are led, said device comprising two primary parts separable along a mating plane and means detachably connecting said parts together, said parts carrying couplers separable along said plane and connected respective to lines leading to and from said device;

11. An assembly as described in claim 2 wherein the transmission has an output shaft: a quick disconnect unit for connecting said output shaft to a drive line universal joint; said quick disconnect unit including mating flanges having drive studs in one slidable fitting in mating bores in the other; and means for clamping said flanges together.

12. An assembly as described in claim 2 wherein there is an exhaust duct system extending from said engine to the vehicle frame and having an outer portion mounted on said frame: a flange type quick disconnect means in said duct system connecting said outer portion to an inner portion of said system; and a complete air intake system mounted solely on said engine unit and carried thereby and removable therewith.

13. An assembly as described in claim 2 wherein said connecting means comprises end plates rigidly connected to said radiator and to the ends of said front cross member; said first detachable means includes bolts on said frame; and said second detachable means includes ears on said engine and bolts for securing said ears to the vehicle frame.

14. A quick exchange engine assembly for mounting in a vehicle frame having spaced, generally parallel, side rails connected together by a front cross member and other cross members;

15. Said assembly including an engine unit and a transmission fixedly secured together;
said assembly including a radiator forwardly of said engine unit;
said assembly including the front cross member of the vehicle frame;
said engine unit being movably mounted on the central portion of said front cross member;
connecting means fixedly securing said radiator to the ends of said front cross member;
first detachable means for detachably connecting said front cross member to frame side rails of the vehicle frame;
second detachable means on the rear portion of said engine unit for detachable connection to the frame side rails of the vehicle frame, whereby said engine assembly can be disconnected from the frame side rails by detaching said first and second detachable means;
said first and second detachable means having vertically extending guide portions for slidable engagement with complementary guides on the side rails;
a link and means for movably connecting said link at its ends to the upper portion of said radiator and to said engine to stabilize the two relative to one another upon removal of the same;
a cluster type quick disconnect device on said engine unit to which electrical and fluid lines are led, said device comprising two primary parts separable along a mating plane and means detachably connecting said parts together, said parts carrying couplers separable along said plane and connected respective to lines leading to and from said device;
said transmission having an output shaft;
a quick disconnect unit for connecting said output shaft to a drive line universal joint;
said quick disconnect unit including mating flanges having drive studs in one slidably fitting in mating bores in the other;
and means for clamping said flanges together;
an exhaust duct system extending from said engine to the vehicle frame and having an outer portion mounted on said frame;
a flange type quick disconnect means in said duct system connecting said outer portion to an inner portion of said system; and
a complete air intake system mounted solely on said engine unit and carried thereby and removable therewith.

9. In a vehicle:

a frame including a pair of spaced side rails;
an engine having housing means and crankshaft means projecting forwardly thereof;
a transmission having a housing connected to the housing means of the engine to form a unit therewith and having rear supports at the sides thereof;
a crossbeam having bearing means receiving the crankshaft means;
a radiator;
side plate means being connected to the radiator and rigidly secured to the cross beam;
first upwardly facing seat portions on the side rails for receiving and supporting the side plate means and the crossbeam;
second upwardly facing seat portions on the side rails for receiving and supporting the rear supports;
first connecting means detachably connecting the crossbeam rigidly to the side rails to locate the bearing means in a predetermined plane; and
second connecting means independent of the first connecting means detachably connecting the sides of the housing of the transmission to the side rails.

10. The vehicle of claim 9 including first vertically tapered guide means for centering the crossbeam between the rails as the unit is lowered to its operative position, and second vertically tapered guide means for centering the transmission between the rails as the unit is lowered to its operative position.

11. The vehicle of claim 10 wherein the first vertically tapered guide means comprises a pair of guide plates rigidly secured to the rails, the guide plates having vertically tapered portions.

12. The vehicle of claim 9 including third vertically tapered guide means for positioning the unit in a predetermined position longitudinally relative to the guide rails as the unit is lowered to its operative position.