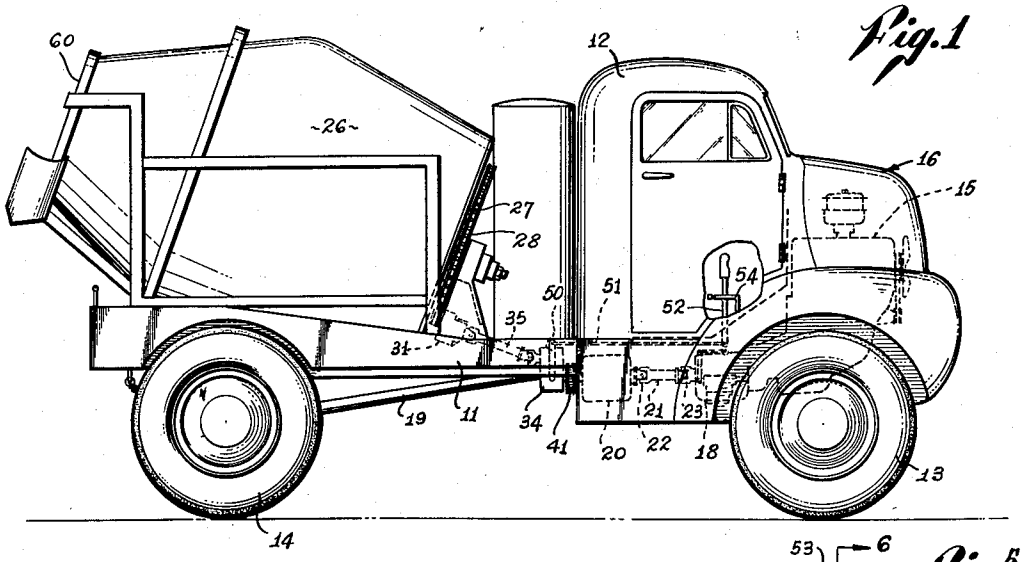
Dec. 8, 1953 C. L. WILLARD 2,661,935

SINGLE MOTOR TRANSIT CONCRETE MIXER

Filed Sept. 27, 1952

Fig. 1



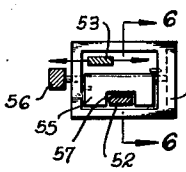
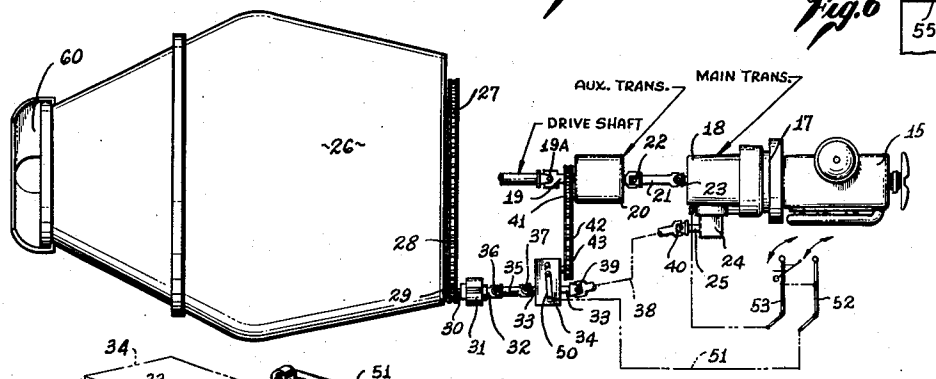


Fig. 5

Fig. 2



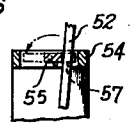


Fig. 6

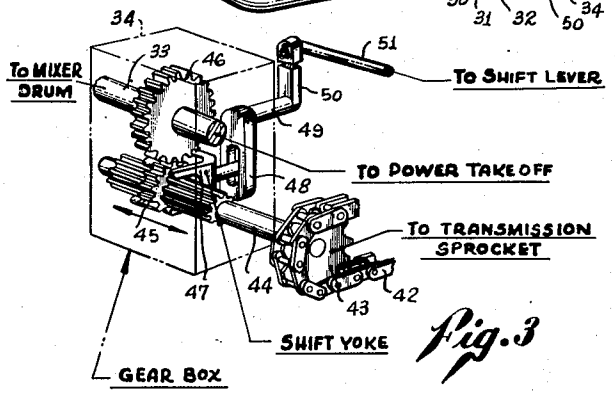


Fig. 3

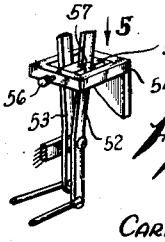


Fig. 4

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Patented Dec. 8, 1953 2,661,935

UNITED STATES PATENT OFFICE

2,661,935

SINGLE MOTOR TRANSIT CONCRETE MIXER

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Application September 27, 1952, Serial No. 311,936

5 Claims. (Cl. 259—177)

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This invention relates to transit concrete mixers.

Early in the development of the concrete mixing art, it became apparent that the mixing could be more economically accomplished at a central plant, particularly one located near gravel and sand pits, and that the mixed wet concrete be then hauled in trucks to the construction jobs on which the concrete was to be used, and there poured. This method of a central mix location and delivery to the job locations requires that the mixing action be substantially continuous from the time the cement, aggregate and water are brought together in the mixing drum until the semi-fluid mass is poured into its final structural position on the job. The agitation of the continuous mixing action prevents segregation of the ingredient materials of the concrete, or undesirable settling of its components while in transit from the mixing plant to the construction job. Thus came into use the transit concrete mixer, comprising a vehicle, means for propelling the vehicle, a mixer mounted on the vehicle, and means for operating the mixer at the plant, while in transit between plant and job, and at the job location.

The vehicle is usually a truck driven by an internal combustion motor, on which is rotatably mounted a concrete mixing drum. This drum may be driven, and in nearly all transit mixers is driven, by a second independently controlled internal combustion motor. But for obvious reasons of economy, of first cost, and of operation, efforts were made from the time the first transit mixers were conceived and constructed, to design a means for driving the mixer by the same motor which drives the truck. These efforts encountered engineering difficulties which have never been satisfactorily overcome. The basic difficulty has arisen from the desirability of continuously and smoothly driving the drum without excessive and long continuing variations of speed, and without hindering the operation of, or causing damage to the truck transmission at those times when the truck is being started, stopped or reversed, or when the speed ratio between its driving wheels and the truck motor is being changed, a change which is conventionally accomplished by shifting the gears of the truck transmission.

While the power transmitting chain of elements between the truck motor on the one hand, and the drum and truck wheels on the other hand, are variously constituted in equipment of this single motor type of transit concrete mixers, one design is in common use and is described as follows. The motor shaft at the forward end of the truck drives the forward element of a friction clutch. The rear clutch element through a conventional gear shift transmission box is drive-connected to the truck wheels, usually only the rear wheels. The truck transmission is conventionally designed to provide three, four or more speeds forward, several speeds in reverse, a neutral idling position, and may also have an overdrive and an underdrive which triples this number of possible speeds. A power takeoff at the front end of the gear shift transmission box is driven by a gear wheel on the main drive shaft of the transmission which rotates at the same speed as the rear friction clutch element.

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The power takeoff is combined with a variable speed transmission which is designed to provide for one or two forward speeds, one or two reverse speeds (for unloading the drum), and a neutral idling position. The mixer drum, mounted to the rear of the cab and extending backward over the truck rear wheels, has a ring sprocket wheel, which is driven by a pinion sprocket, which is in turn driven by the power takeoff through a two-speed gear shift box. This latter feature enables the drum to be driven at a fast speed for initial mixing, and a slow speed for the later phases of the mixing operation, and also and primarily for agitation to prevent the mix from setting or separating while driving to the job and before it is poured from the mixer at the construction site.

No difficulty is met in controlling the operation of the drum when the truck is stationary at either end of its travel between the mixing plant and the construction job. The truck transmission is placed in neutral, the wheels braked, and the drum rotation controlled by the engine throttle, by the gear shift in the power takeoff, and by the two-speed drum gear shift box. But when the truck is in motion and the drum is loaded and turning, and it is desired to shift the truck transmission gears in starting, on hills, or to meet traffic conditions, the rotation of the forward end of the truck transmission continues after the friction clutch is thrown out, due to the momentum of the loaded drum which is power-tied to the forward end of the truck transmission by the power takeoff. The power takeoff cannot, to advantage, be shifted to neutral by the operator, for that operative step will slow down and stop the drum, and the power takeoff must be later shifted back.

While a short cessation of rotation of the drum may not be serious, two extra control steps are required in shifting the power takeoff to and from

neutral, which complicates the mental reactions required of the operator. Release of the motor friction clutch incidental to shifting the truck transmission gears does not help the situation, for the forward end of the transmission box shaft continues to rotate under the power of the momentum of the drum, and the driven shaft at the rear of the transmission is driven by the truck wheels, making it difficult and at times impossible to bring into mesh and shift the truck transmission gears. They are not only operating at different speeds, but are both heavily loaded at these different speeds. The gear load due to the momentum of the drum is, of course, greater when the drum is loaded with relatively dry-mixed concrete. If the clutch is held long enough in the release position while efforts to shift the truck transmission are being made, the drum may stop, and then, due to the weight of the concrete load, it will begin a reversing oscillation which increases the relative difference in speed of the loaded gears and increases the difficulty of smoothly shifting them, and in fact, of shifting them at all.

It is also obvious that if the drum is disconnected by the operator from the motor shaft to free the truck drive from the ill effects of the momentum of the rotating drum, agitation stops, and the power takeoff must again be connected after the meshing of the gears of the truck transmission gear box has been accomplished. This reconnection of the drum to the motor throws an extra load suddenly on the motor, affects the speed pickup of the truck, and may create a driving hazard.

Some of the disadvantages of a positive drive between the motor shaft and the drum have been cited. It has been proposed to place a friction clutch between the motor shaft and the drum, as for instance in the power takeoff box. This, however, must be controlled by the operator, increasing the demands upon his attention and complicating the operation of the equipment. It has also been proposed to automatically brake the drum drive when the power takeoff is shifted to neutral, but in this arrangement, the power takeoff must be shifted to and from neutral, with the disadvantages cited above.

In spite of these efforts to produce a practicable single motor drive in a transit concrete mixer, the mixers now in use are virtually all equipped with an independent motor drive for the drum, which is significant of the absence at the present time of any successful solution of the operative problems presented in the design of a single motor drive.

This problem of many years' standing may be briefly stated as that of so designing a single motor transit concrete mixer that control of each of the driven elements, i. e., the truck wheels and the mixer drum, may be achieved without hindrance from the operating movement of the other element.

According to this invention, this problem has been successfully solved by providing a power takeoff from the forward end of the truck drive transmission for driving the mixer drum, also providing an alternate drive for the drum from the truck drive shaft at some point between the truck drive transmission and the truck propelling wheels, and further providing means for selectively connecting either of these drives, but only one at a time.

In the drawing, which depicts one embodiment of the invention, and is for illustrative purposes only:

Figure 1 is a side elevation of a transit concrete mixer embodying the invention;

Figure 2 is a schematic top plan view of the power plant, and truck wheel and drum drives;

Figure 3 is a perspective view of a portion of the drum drive;

Figure 4 is a perspective view of the control mechanism for the two drum drives;

Figure 5 is a top plan view of this control mechanism shown partly in section; and

Figure 6 is a vertical sectional view taken along the line 6—6 of Figure 5.

The truck shown is of conventional design, having a chassis frame 11, a cab 12, front steering wheels 13, and rear drive wheels 14. An internal combustion motor 15 (see Figures 1 and 2) mounted under the hood 16 drives one element of a friction clutch 17, the friction clutch being carried by the rear end of the motor shaft (not shown). The driven element of this clutch is mounted on a shaft (not shown) which extends into the housing 18 of the truck gear shift assembly or transmission as it is usually termed, and from which power is transmitted at various speeds and in both directions of rotation, to the drive shaft 19, and thence to the rear wheels 14 through the usual universal couplings (one of which is shown at 19a) and differential drive, all in accordance with standard truck design.

In the truck shown in the drawing, an auxiliary transmission 20 is provided, suitably connected to the main transmission 18 by a short drive shaft 21 and universal couplings 22 and 23. It will be understood, however, that as far as this invention is concerned, from a functional standpoint the transmissions 18 and 20 may be considered as one transmission element of the truck drive.

A power takeoff 24 mounted on the side of the housing 18 is driven by a gear wheel (not shown) rigidly carried by the shaft which extends from the driven friction clutch element into the transmission box 18. The initial element of this power takeoff thus rotates at a speed which bears a constant speed ratio to the driven element of the clutch 17, and when the clutch 17 is engaged, also bears a constant speed ratio to the motor. The power takeoff 24 is constructed to transmit rotative movement to a shaft 25 through a gear shift assembly within the housing of the power takeoff. This gear shift assembly may be shifted to a neutral idling position, to one or more positions for driving the shaft 21 in one direction of rotation, and to one or more positions for driving the shaft 21 in the other direction of rotation, by a control device to be later described.

A mixer drum 26 is mounted to rotate on the truck chassis with its axis in a forwardly and downwardly inclined position. It may be mounted for tilting to unload or may be designed, as is the transit mixer shown in the drawing, for unloading by reversing the direction of its rotation. Since the means for unloading the drum, supplying material and water to the drum, and many other features of the transit mixer may be varied without affecting the nature of the invention, no detailed description of such features will be given here.

The drum has rigidly and coaxially mounted upon it a large sprocket wheel 27 which engages a sprocket chain 28 driven by a small sprocket wheel 29. The sprocket wheel 29 is fixedly carried by a shaft 30 of a two-speed transmission

gear box 31 suitably mounted on the truck chassis (see Figure 2).

The driving shaft 32 of this gear box 31 is coupled to a shaft 33 mounted in a suitably secured transmission box 34, through a short shaft 35 and universal couplings 36 and 37. The shaft 33 which projects through both the forward and rear walls of the box 34, is coupled to the shaft 25 of the power takeoff 24 by a shaft 38 and universal couplings 39 and 40. When, now, the gear shift assembly of the power takeoff is shifted to a driving position in either direction of rotation, the drum 26 is rotated in the corresponding direction. The drum is designed to be rotated in one direction for mixing the concrete-making materials at the mixing yard, and in the other direction for unloading the mixed concrete at the construction site. During either of these operations, the mixer truck is stationary, and the truck transmission 18 is adjusted to the neutral position. During the mixing operation, the gears of the gear box 31 are shifted by a control connection (not shown) in the cab to operate the drum at the greater of the two speeds at which it may be operated.

After the mixing operation at the mixing plant has been completed, the power takeoff control lever is shifted to place the gears in the power takeoff transmission box 24 in neutral. The drum is then driven directly from the main truck wheel drive shaft 19 in a manner to be now described, and the speed of the drum then bears a constant proportional relationship to the speed of the driving wheels 14 of the truck. Obviously when the drum is driven from the engine 15, through the power takeoff 24, there must be no driving connection between the truck wheel drive shaft 19 and the drum.

The drive from the shaft 19 to the drum comprises a sprocket wheel 41 fixed upon the shaft 19, a sprocket chain 42, a sprocket wheel 43 (see Figure 3) on a countershaft 44 journaled in bearings in the gear box 34, a longitudinally shiftable pinion gear 45 splined on the countershaft 44, and a spur gear 46 fixedly mounted on the shaft 33. The pinion gear 45 may be shifted into and out of mesh with the spur gear 46 by a yoke 47 which may be operated from the cab by any suitable means, such as the slotted lever 48, shaft 49, lever arm 50, link 51 and control lever 52 in the cab (see Figures 1, 2 and 4).

In a mixer constructed in accordance with this invention, the drum rotates in a clockwise direction looking forward, when it is connected to the main truck wheel drive shaft when the pinion gear is shifted to the gear meshing position. A standard truck motor revolves in a counterclockwise direction, looking forward, and the pinion gear 45 must, from the nature of its coupling to the drive shaft 19, also rotate in this direction. The rising side of the mixer drum carries the greater part of the load of the concrete mix. This heavy side of the drum is to the left of the center line of the truck and tends to prevent the truck turning over toward the right-hand edge of the highway which is usually the lower side of the highway. If the drum revolves in the other direction of rotation, the concrete load would be on the right-hand side of the center line of the truck. The right-hand tires would be subject to excessive wear. Also the truck might easily overturn if the truck were given a slight additional list to the right by some change in road conditions.

Consequently, the power coupling from the main drive shaft to the drum is arranged to rotate the drum in a direction opposite of the direction of rotation of the motor.

The cab lever 53 shifts the power takeoff transmission 24 into neutral position, into position to rotate the drum in one direction, or into position to rotate the drum in the other direction. To prevent simultaneous coupling of the drum to the engine through the power takeoff, and to the truck wheel drive shaft 19, with the result of either "killing" the engine if the friction clutch is engaged, or almost certainly whether the clutch is in or out, breaking some part of the power transmitting mechanism, the upper ends of the levers 52 and 53 are enclosed in a horizontally disposed frame 54 suitably mounted in the cab. A locking plate 55 is mounted in trunnion fashion on an axis between these two levers and may be manually rotated by the knurled knob 56 either to the position shown in full lines in Figure 5 in which the slot 57, centrally located along its outer edge, engages the lever 52 in its neutral position and prevents shifting this lever rightward in the direction of the arrow for driving the drum from the shaft 19, while permitting free shifting of the lever 53 on the other side of the frame 54 in either of the directions indicated by the arrow to drive the drum from the engine through the power takeoff in either direction of rotation, respectively.

The speed of the motor is controlled by the usual throttle operating lever; the friction clutch 17 is controlled by the usual foot or hand lever; and the truck transmissions 18 and 20 by suitable gear shift levers. If desired, controls additional to the cab controls may be provided at the rear of the truck for use by the operator when the truck is stationary at the mixing plant or at the construction site.

In the operation of the above-described transit concrete mixer equipped in accordance with this invention, the truck is driven to position with the material-receiving open end 60 of the drum 26 under the hopper of the batch mixer (not shown) at the central mixing plant. The lever 53 of the power takeoff is in its central, neutral position, locking plate 55 holding it there. The lever 52 is in its right-hand "on" position. The truck is stopped, lever 52 is shifted to its center "off" position, plate 55 is turned over, lever controlling gear box 31 is shifted to "high," and the lever 53 shifted from center to the position for mixing rotation of the drum. The clutch 17 is held out of engagement and the motor preferably throttled to idling speed during these shifts. When the clutch is engaged, the drum begins rotation in the mixing direction. The motor is brought to normal speed. The concrete materials and mixing water are then run into the drum, and given an initial mixing agitation. The motor speed for all operations of either drum or truck should be at a given rated value for maximum efficiency, as for example, 1600 R. P. M. The power transmitting devices between the motor and the drum, when the drum is being rotated for mixing, are such that at 1600 R. P. M. of the motor, the drum is turning at 10 R. P. M. for receiving and mixing the concrete materials.

When the drum is completely loaded and given its initial mix, the gear box 31 is shifted to "low," lever 53 is shifted to neutral, plate 55 is turned over to lock lever 53 in neutral, lever 52 is moved to the right causing pinion 45 to mesh with gear

46, the truck is started and brought to up road speed by appropriate operation of the clutch 17, and appropriate shifts of the truck transmission lever or levers. The drum then rotates at an average speed of 5 R. P. M. which, however, varies directly as the linear travel speed of the truck.

During numerous shifts of the truck transmission gears in starting from the mixing plant, later for stops, such as at road crossings, or in changing speeds in response to changing road grades and traffic conditions, the ratio of drum speed to truck speed remains constant and therefore the load on the driven gears of the truck transmission increases and decreases at a uniform rate of change. The driver may therefore ignore the load of the revolving drum on the driven transmission gears, and has only to throw out the clutch and ease the freely turning and unloaded driving gears into mesh with the driven gears of the transmission. Since the driving gears are free of any load but the slight one of their own inertia, this shift is very readily accomplished. It is also to be noticed that the speed of the drum varies only with the speed of the truck while thus in transit from mixing plant to construction site, a variation which is much less than that which takes place under former practice when the drum is coupled with the engine through the power takeoff. Under the former condition, the drum speed may drop to zero or the drum may even rotate in the reverse direction when the main friction clutch is disengaged.

When the truck arrives at the construction site, the main drive shaft is uncoupled from the drum, the power takeoff is shifted to the unloading position with appropriate adjustment of the locking plate 55 and the batch is poured into the forms or other place of deposit. After the drum is emptied of its load of mixed concrete, the power takeoff transmission is placed in neutral, the main truck drive shaft is coupled to the drum, and the equipment is returned to the mixing location with the drum turning slowly at its transit speed of rotation.

This invention has been described as adapted to a transit concrete mixer of one type in which the truck is of conventional design as to its power plant, driving mechanism, and controls. The invention is applicable to transit concrete mixers of varied design, both as to the mixing elements and as to the transportation elements of the equipment. The invention, therefore, is not limited as to its scope to the particular machinery equipment hereinabove described, but embraces all equipment of the transit concrete mixer class which is described and defined in the appended claims.

I claim:

1. In a transit concrete mixer, the combination of: an automotive vehicle having driving wheels; a motor mounted on the vehicle; a first train of power transmitting devices connecting the motor and the driving wheels of the vehicle, including a variable speed transmission providing for at least one forward driving speed, at least one reverse driving speed, and a neutral non-driving adjustment; a rotary concrete mixing drum mounted on the vehicle; a second train of power transmitting devices connecting the drum to an element of the first train between the motor and the transmission; a third train of power transmitting devices connecting the drum to an element of the first train of power transmitting devices between the transmission and the wheels; a throw-out clutch in said second train; a throw-out clutch in the third train, a pair of controls for the throw-out clutches, respectively; and a single, two-position member for locking one of the controls in the throw-out position and simultaneously freeing the other control for operation to the throw-in position when said member is in one position, and vice-versa.

2. In a transit concrete mixer, the combination of: an automotive vehicle having a motor, a friction clutch, a multiple selective speed, reversible rotation and throw-out transmission, a main drive shaft and driving wheels connected in the order named; a mixing drum; a power takeoff connecting the drive shaft between the clutch and transmission to the drum, the power takeoff having a transmission providing for rotation in either direction of rotation, and also a throw-out clutch; a power coupling between the main drive shaft and the drum, geared to drive the drum clockwise looking forward, and including a throw-out clutch; a control for the power takeoff throw-out clutch; a control for the throw-out clutch of said power coupling; and a single, two-position member for locking one of said controls in the throw-out position and simultaneously freeing the other control for operation to the throw-in position when said locking member is in one of its two positions and vice versa.

3. The combination definied in claim 2, in which the transmission is of the type having axially slidable gear wheels with intermeshing teeth.

4. The combination defined in claim 2, in which there is a variable speed transmission providing for at least two speeds of rotation of the drum in the same direction and disposed operatively between the drum on the one hand and both the power takeoff and power coupling on the other hand.

5. In a concrete transit mixer, the combination of: a truck chassis; a motor on the chassis; a friction clutch, an intermediate drive shaft, a variable speed, reversible and throw-out transmission, a main drive shaft and truck driving wheels connected in the order named; a mixing drum; power transmitting devices for the drum; a power takeoff coupling the intermediate shaft and said devices, and having a transmission with at least three position of adjustment, providing for rotation in either direction, and a throw-out; a power coupling between the main drive shaft and the said power transmitting devices; a throw-out clutch in said power coupling; two controls for said two last-mentioned throw-outs; and a single, two-position member for locking one of said controls in the throw-out position and simultaneously freeing the other control for operation to the throw-in position when said member is in one of its two positions and vice versa.

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