J. B. FOOTE.

VARIABLE SPEED DRIVING MECHANISM FOR TRACTORS.

APPLICATION FILED OCT. 4, 1919.

1,419,243. Patented June 13, 1922.

3 SHEETS—SHEET 1.

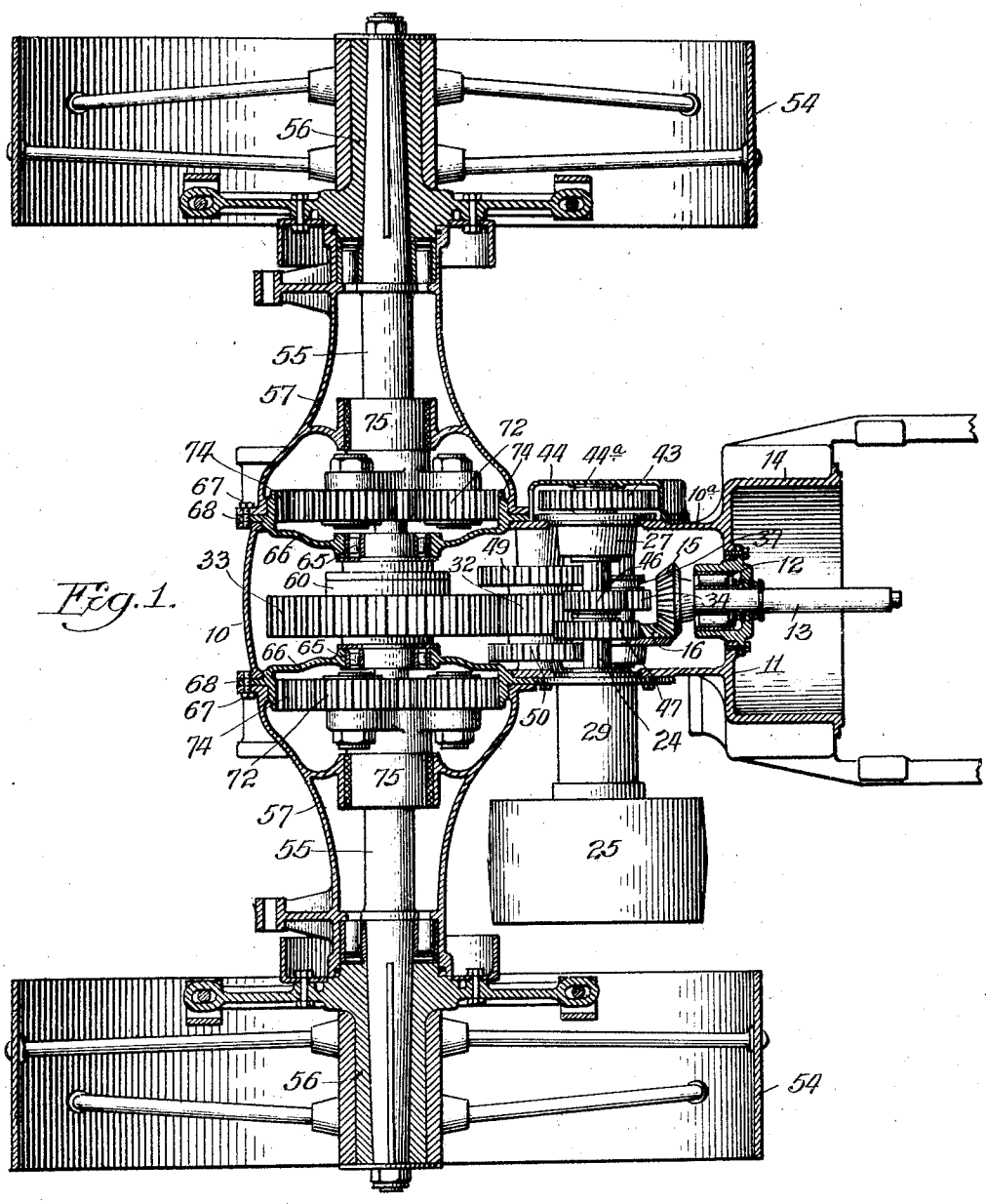

Fig. 1.

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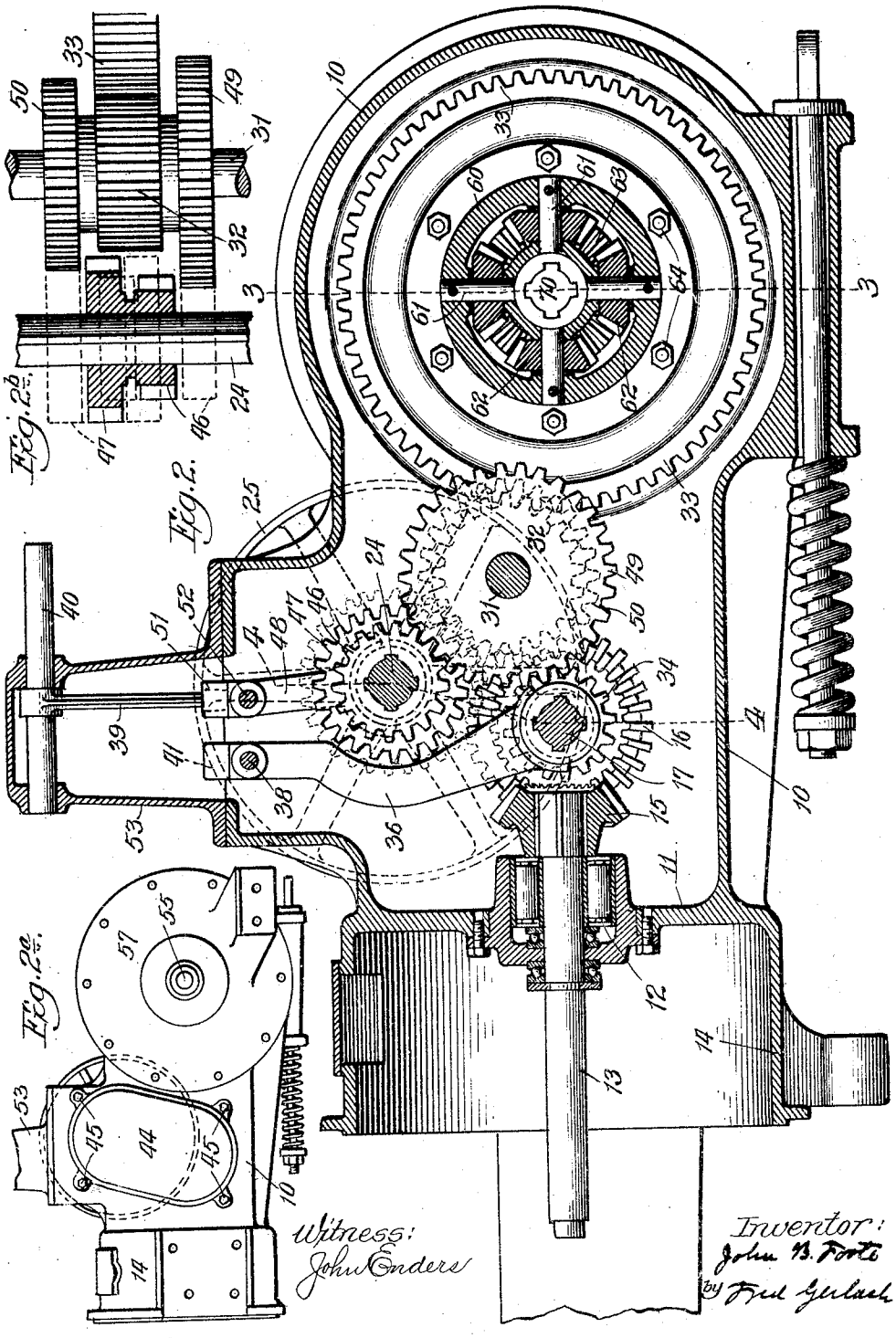

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3 SHEETS—SHEET 3.

Fig. 3.

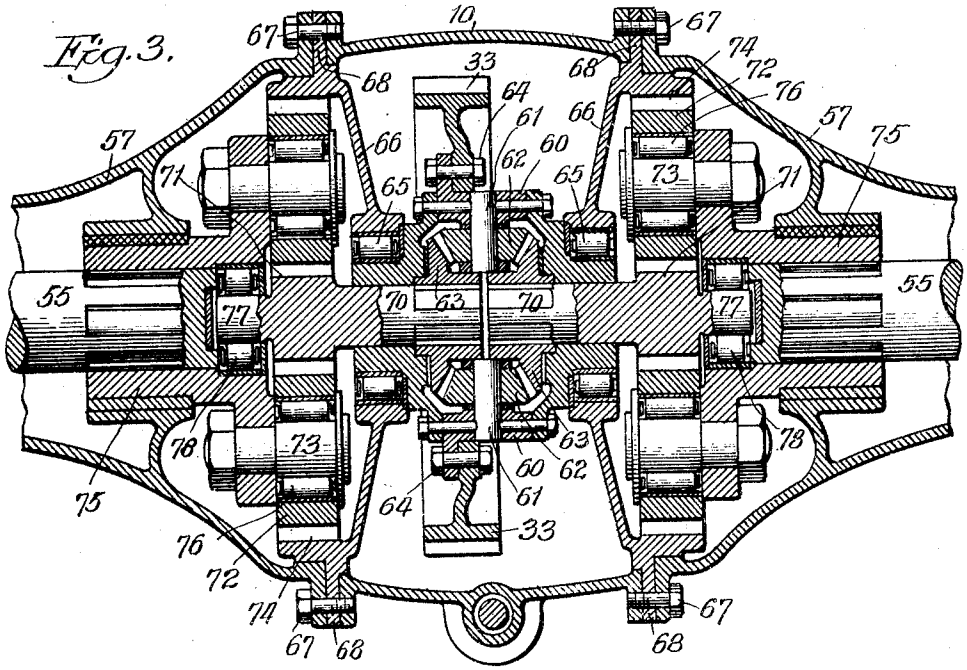
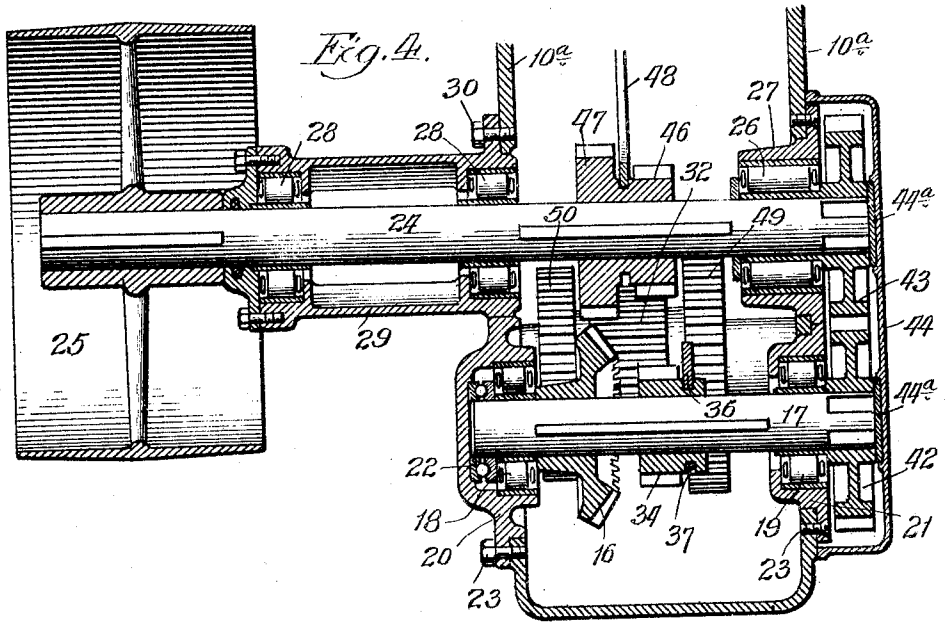


Fig. 4.



Witness:
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UNITED STATES PATENT OFFICE.

JOHN B. FOOTE, OF OAK PARK, ILLINOIS.

VARIABLE-SPEED DRIVING MECHANISM FOR TRACTORS.

1,419,243. Specification of Letters Patent. **Patented June 13, 1922.**

Application filed October 4, 1919. Serial No. 328,487.

To all whom it may concern:

Be it known that I, JOHN B. FOOTE, a citizen of the United States, and a resident of Oak Park, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in Variable-Speed Driving Mechanism for Tractors, of which the following is a full, clear, and exact description.

The invention relates to variable speed driving mechanism for tractors and its object is to provide an improved construction in which the gearing is compactly arranged so as to avoid a long gear-case and in which one of the cross-shafts of the variable speed-driving mechanism is elevated to render it usable as a service shaft for driving a pulley which is adapted to drive some mechanism other than the tractor itself. Other objects will appear from the detail description.

The invention consists in the several novel features hereinafter set forth and more particularly defined by claims at the conclusion hereof.

In the drawings: Fig. 1 is a plan of mechanism embodying the invention. Fig. 2 is a central vertical longitudinal section. Fig. 2^a is a side elevation of the gear-case. Fig. 2^b is a detail of the high and low speed pinions and the gears with which they mesh. Fig. 3 is a transverse section taken on line 3—3 of Fig. 2. Fig. 4 is a section taken on line 4—4 of Fig. 2.

The variable speed-gearing is enclosed in a case 10 which is adapted to contain lubricant and serves as an enclosure and a support therefor. The front portion of the case 10 is provided with a wall 11 containing a suitable bearing 12 for a longitudinal shaft 13 which is driven from the usual motor (not shown) through a clutch disposed in a housing 14. A bevelled pinion 15 is fixed to the rear and inner end of the drive-shaft 13 and meshes with a gear 16 which is keyed to a cross-shaft 17. Drive-shaft 13, pinion 15, gear 16 and cross-shaft 17 are constantly driven while shaft 13 is being driven by the motor. Shaft 17 is mounted in bearings 18 and 19 which are carried in heads 20 and 21 which are removably secured by bolts 23 in the sides 10^a respectively of the case. A thrust-bearing 22 is provided for one end of shaft 17. A first counter-shaft 24, which is used as a drive shaft for an outside service-pulley 25, is mounted in a bearing 26 carried by a removable head 27 which is secured in one side 10^a of the case 10 and in bearings 28 carried by a sleeve 29 which is secured by bolts 30 in the other side of case 10. This service-shaft is disposed above the plane of shaft 17 so that the service-pulley will be disposed at an elevation which will leave maximum clearance for the belt driven by the service-pulley and where it will be accessible for the application and removal of the belt. A second counter-shaft 31 is fixedly sustained in the sides of the case 10 and is disposed rearwardly of the shafts 17 and 24. A gear 32 meshing with and for driving a ring-gear 33 of the differential gearing, on the rear axle of the tractor, is rotatably mounted on shaft 31.

A gear 42 is removably secured to one end of the shaft 17 which projects outwardly from one side of case 10 and meshes with a gear 43 which is removably secured to the projecting end of the service-pulley shaft 24 at the same side of the case. Shaft 24 is used to drive the high and low speed gears and the purpose in removably securing the gears on the outside of the case 10 is to permit substitution of gears of different sizes to vary the relative speed ratio of the shafts 17 and 24. For example, when the tractor is to be used for plowing in extremely heavy soil and it is desirable to reduce the speed of shaft 24 or when a different speed of the service-pulley is desired, said speed changes can be readily effected by the substitution for gears 42 and 43 of gears which will produce the desired reduction or increase of speed between shafts 17 and 24. A cover 44 for gears 42 and 43 is removably secured to one side of case 10 by bolts 45. Wear-plates 44^a are secured in said cover.

A low-speed pinion 46 and an integral high-speed pinion 47 are slidable on and constantly rotatable with the service-shaft 24. An arm 48 extends into a groove in the hub between said pinions and is adapted to slide the low-speed pinion 46 into or out of mesh with a large gear 49 which is integral or secured to rotate with gear 32 which meshes with the ring-gear 33 of the differential gearing on the rear axle. Said arm 48 is also adapted to slide the high-speed pinion 47 into and out of mesh with a small gear 50 which is also integral or secured to rotate with gear 32. An arm 39 on a slidable rock-shaft 40 is adapted to enter a groove 51 in the upper end of arm 48 to slide the arm cross-wise of the case 10 and on a guide-rod

52. Arm 48 is disposed in, and rock-shaft 40 is slidable in, a housing 53 secured to the top of case 10.

The reverse gearing comprises a pinion 34 which is slidable on, and rotates constantly with, shaft 17 and is adapted to be shifted into mesh with gear 49, to drive said gear directly from shaft 17 while service-shaft 24 will run idly. An arm 36 extending into a groove 37 in the hub of reverse-pinion 34 is slidable on a guide-rod 38 and adapted to slide said pinion into and out of mesh with gear 49 to control the reverse-drive. Arm 39 on rock-shaft 40 is adapted to be moved into a groove 41 in the upper end of arm 36 and to slide said arm on rod 38 and thus control the reverse drive.

The tractor operated by the driving mechanism comprises traction-wheels 54, 54, an axle composed of members 55, 55, hubs 56 keyed on the ends of the outer axle-members respectively and connected to drive the traction-wheels and sleeves 57, 57 between the sides of case 10 and said hubs.

The differential gearing comprises a drum 60 to which ring-gear 33 is secured by bolts 64, radial arbors 61 mounted in the drum, pinions 62 on said arbors and bevel gears 63 meshing with said pinions. The hub of each gear 63 is mounted in a bearing 65 in a head 66 which is removably secured to and held in an opening in one side of the case 10 by bolts 67. These heads have flanges 68 which are clamped between the sleeves 57 and the case 10. Stub-shafts 70 are secured in and driven by the gears 63 and respectively extend through the sides of the drum 60, and each has a pinion 71 at its outer end to drive a planetary reducing gearing between the differential gearing and one of the axle members. Each reducing gearing comprises a series of planetary pinions 72 mounted on studs 73 respectively, meshing with a pinion 71 and an internal gear 74 formed on one of the heads 66. Studs 73 are secured to a hub 75 which rotates in a bearing provided adjacent the inner end of one sleeve 57 and is secured on the inner end of, and drives one axle-member 55. Studs 77 are provided on the outer ends of pinions 71 are sustained in bearings 78 carried by the hubs 75. A characteristic of this construction is that the internal gear is in or formed in a head or plate which is removable from the case when the adjacent sleeve 57 has been removed. When bolts 67 are removed, the sleeves 57 and axle-members can be removed, the latter being removable from hubs 75, leaving the reducing gearing in the heads 66. When the sleeves have been removed, these heads and the reducing gearing can also be removed if desired. Thus, this construction exemplifies one which may be easily assembled and disassembled when repair or replacement of a part is necessary.

The operation will be as follows: When the reverse pinion 34, low-speed pinion 46 and high-speed pinion 47 are in their idle positions, there will be no driving connection for the gears on shaft 37 so that the differential gearing will be idle and the service-shaft 24 will be driven by gears 42 and 43. When the tractor is to be operated at low speed, shaft 40 will be rocked to cause arm 39 to operate controller 48 to slide pinion 46 into engagement with gear 49 so that gear 32 will drive the differential gearing at low-speed. To operate the tractor at high-speed, arm 39 will be operated to slide gear 47 into mesh with gear 50 so that gear 32 will drive the differential gearing at high-speed. To reverse the tractor, shaft 40 will be shifted to bring arm 39 into groove 41 of controller 36 and then rocked to slide the reverse-pinion 34 into mesh with gear 49 and then gear 32 will drive the differential gearing in reverse direction.

The invention exemplifies variable speed driving mechanism for tractors in which the counter-shaft is utilized as a service-shaft, is disposed above the cross-shaft receiving power directly from the motor; in which the reverse pinion is mounted on the first cross-shaft and the high and low-speed pinions on the second cross-shaft; in which the gears between the first two cross-shafts are on the outside of the case so they can be readily changed to vary the speed of the second-shaft; and in which the internal gears of planetary reducing gearing between the differential gearing and the axle are formed in heads which are removably secured to the sides of the gear-case and between said case and the axle-sleeves.

The invention is not to be understood as restricted to the details set forth, since these may be modified within the scope of the appended claims, without departing from the spirit and scope of the invention.

Having thus described the invention, what I claim as new and desire to secure by Letters Patent, is:

1. In variable speed-transmission gearing for tractors, the combination of a case adapted to retain lubricant, differential gearing, two transverse shafts mounted in the case and substantially parallel to the axis of the differential gearing, gearing for driving one of said shafts from a motor, variable speed pinions on the other of said shafts, gearing between the variable speed pinions and the differential gearing comprising a pair of constantly meshing gears, one of said shafts being disposed substantially above the other to avoid elongation of the case, the gearings, shafts and pinions being enclosed by the case, and gearing between said shafts.

2. In variable speed transmission gearing for tractors, the combination of a case adapted to retain lubricant, differential gearing,

two transmission shafts mounted in the case and substantially parallel to the axis of the differential gearing, gearing for driving one of said shafts from a motor, variable speed pinions on the other of said shafts, gearing between the variable speed pinions and the differential gearing comprising a pair of constantly meshing gears, one of said shafts being disposed substantially above the other to avoid elongation of the case, the gearings, shafts and pinions being enclosed by the case, and changeable gears removably held on the shafts and meshing with each other.

3. In variable speed transmission gearing for tractors, the combination of a case adapted to retain lubricant, differential gearing, two transverse shafts mounted in the case and substantially parallel to the axis of the differential gearing, gearing for driving one of said shafts from a motor, variable speed pinions on the other of said shafts, gearing between the variable speed pinions and the differential gearing comprising a pair of constantly meshing gears, one of said shafts being disposed substantially above the other to avoid elongation of the case, the gearings, shafts and pinions being enclosed by the case, and gears removably held on said shafts so that the speed ratio between said shafts may be varied by changing the gears.

4. In variable speed transmission gearing for tractors, the combination of a case adapted to retain lubricant, differential gearing, two transverse shafts mounted in the case and substantially parallel to the axis of the differential gearing, gearing for driving one of said shafts from a motor, variable speed pinions on the other of said shafts, gearing between the variable speed pinions and the differential gearing comprising a pair of constantly meshing gears, one of said shafts being disposed substantially above the other to avoid elongation of the case, the gearings, shafts and pinions being enclosed by the case, and changeable gears outside the case, removably held on said shafts and meshing with each other.

5. In variable speed-transmission gearing for tractors, the combination of a case adapted to retain lubricant, differential gearing, two transverse shafts mounted in the case and substantially parallel to the axis of the differential gearing, gearing for driving one of said shafts from a motor, variable speed pinions on the other of said shafts, gearing between the variable speed pinions and the differential gearing comprising a pair of constantly meshing gears, one of said shafts being disposed substantially above the other, to avoid elongation of the case, the gearings, shafts and pinions being enclosed by the case, changeable gears outside of the case removably held on said shafts and meshing with each other, and a removable cover enclosing said gears.

6. In variable speed transmission gearing for tractors, the combination of a case, differential gearing, two transverse shafts mounted in the case and substantially parallel to the axis of the differential gearing, gearing for driving one of said shafts from a motor, variable speed pinions on the other of said shafts, gears between the variable speed pinions and the differential gearing, one of said shafts being disposed substantially above the other to avoid elongation of the case, an outside service-pulley on the upper shaft, and gears between said shafts said gearings, shafts and pinions being completely enclosed by said case.

7. In variable speed transmission gearing for tractors, the combination of a case, differential gearing and variable speed gearing comprising a plurality of cross-shafts mounted in the case, one of which is disposed above the other to avoid elongation of the case, high and low speed and reverse pinions in the case, gears between the pinions and the differential gearing, and gears between the shafts, the upper shaft being extended to the outside of the case to operate as a service-shaft said gearings, shafts and pinions being completely enclosed by said case.

8. In variable speed transmission gearing for tractors, the combination of a case, differential gearing and variable speed gearing comprising a plurality of cross-shafts mounted in the case, one of which is disposed above the other to avoid elongation of the case, high and low speed pinions in the case, gears between the pinions and the differential gearing, and changeable gears between the shafts, the upper shaft being extended to the outside of the case to operate as a service-shaft said gearings, shafts and pinions being completely enclosed by said case.

9. In variable speed transmission gearing for tractors, the combination of a case, a cross-shaft, means to drive said shaft from a motor, a first countershaft disposed above the cross-shaft, a second countershaft, high and low speed pinions on the first countershaft, gears between said pinions and the second countershaft, said shafts, pinions and gears being enclosed by said case, and gears between said cross-shaft and the first countershaft.

10. In variable speed transmission gearing for tractors, the combination of a case, a cross-shaft, means to drive said shaft from a motor, a first countershaft disposed above the cross-shaft, a second countershaft, high and low speed pinions on the first countershaft, gears between said pinions and the second countershaft, said shafts, pinions and gears being enclosed by said case, and gears between said cross-shaft and the first countershaft, disposed outside of the case.

11. In variable speed transmission gearing for tractors, the combination of a case, a cross-shaft, means to drive said shaft from a motor, a first countershaft disposed above the cross-shaft, a second countershaft, high and low speed pinions on the first countershaft, gears between said pinions and the second countershaft, said shafts, pinions and gears being enclosed by said case, and changeable gears between said cross-shaft and the first countershaft.

12. In variable speed transmission gearing for tractors, the combination of a case, a cross-shaft, means to drive said shaft from a motor, a first countershaft disposed above the cross-shaft, a second countershaft, high and low-speed pinions on the first countershaft, gears between said pinions and the second countershaft, a reverse pinion on the cross-shaft and adapted to mesh with one of the gears on the second countershaft, and gears between said cross-shaft and the first countershaft.

13. In variable speed transmission gearing for tractors, the combination of a case, a cross-shaft, means to drive said shaft from a motor, a countershaft, high and low speed pinions on the countershaft, gears driven by said pinions, a reverse-pinion on the cross-shaft, adapted to mesh with one of said pinion-driven gears, and gears between said shafts.

14. In variable speed transmission gearings for tractors, the combination of a case, a longitudinal motor-driven shaft in one end of the case, a cross-shaft, bevelled gears between said shafts, a countershaft, gears between the cross-shaft and the countershaft, high and low speed pinions on the countershaft, gears driven by and adapted to mesh with said pinions, and a reverse pinion on the cross-shaft and adapted to mesh with the gear driven by the low-speed pinion.

15. In variable speed transmission gearing for tractors, the combination of a case, a longitudinal motor-driven shaft in one end of the case, a cross-shaft, bevelled gears between said shafts, a countershaft, changeable gears between the cross-shaft and the countershaft, high and low speed pinions on the countershaft, gears driven by and adapted to mesh with said pinions, and a reverse-pinion on the cross-shaft and adapted to mesh with the gear driven by the low-speed pinion.

JOHN B. FOOTE.