May 21, 1963 C. E. KURTZ 3,090,248

WASHING MACHINE MECHANISM

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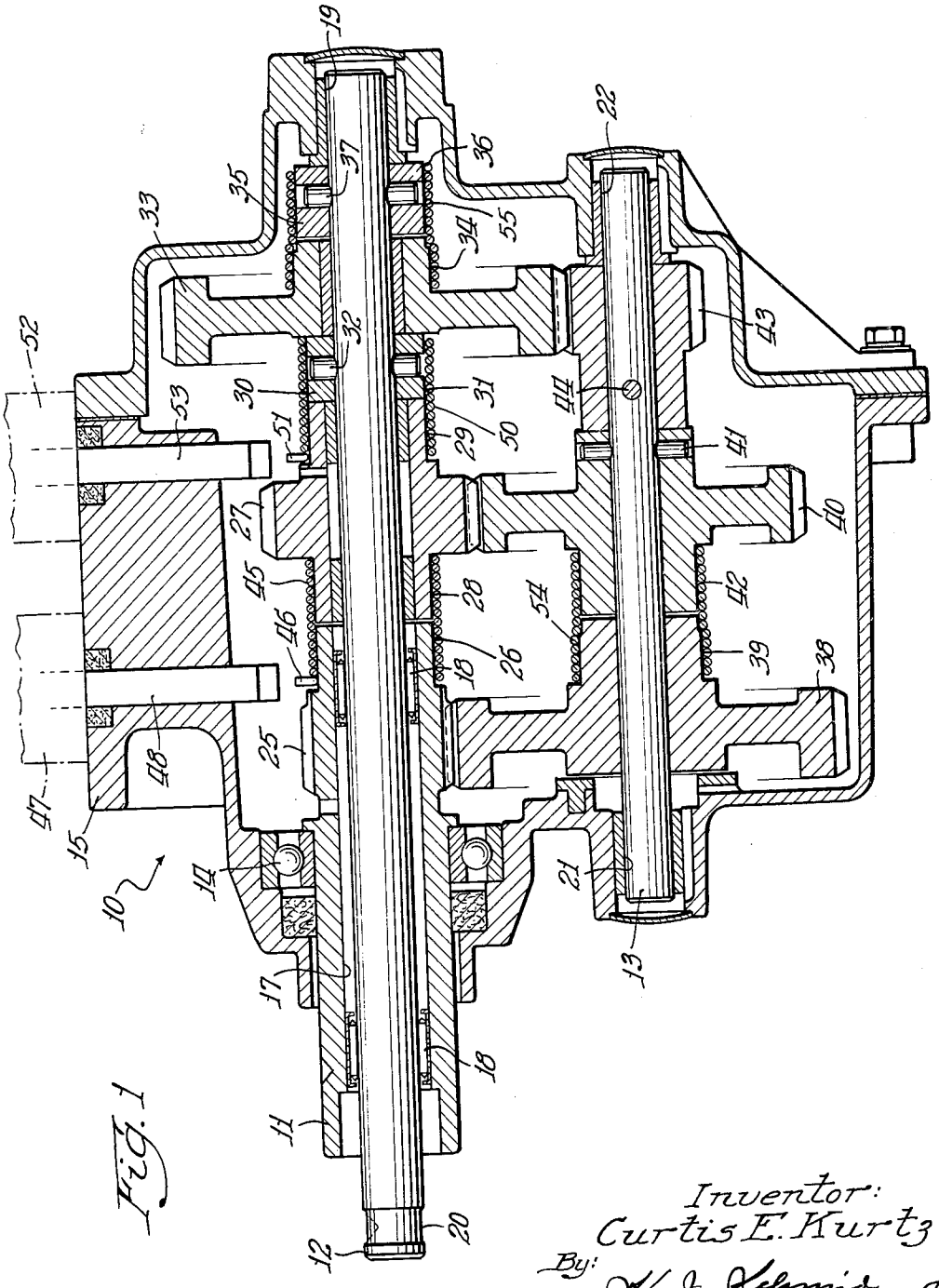


Fig. 1

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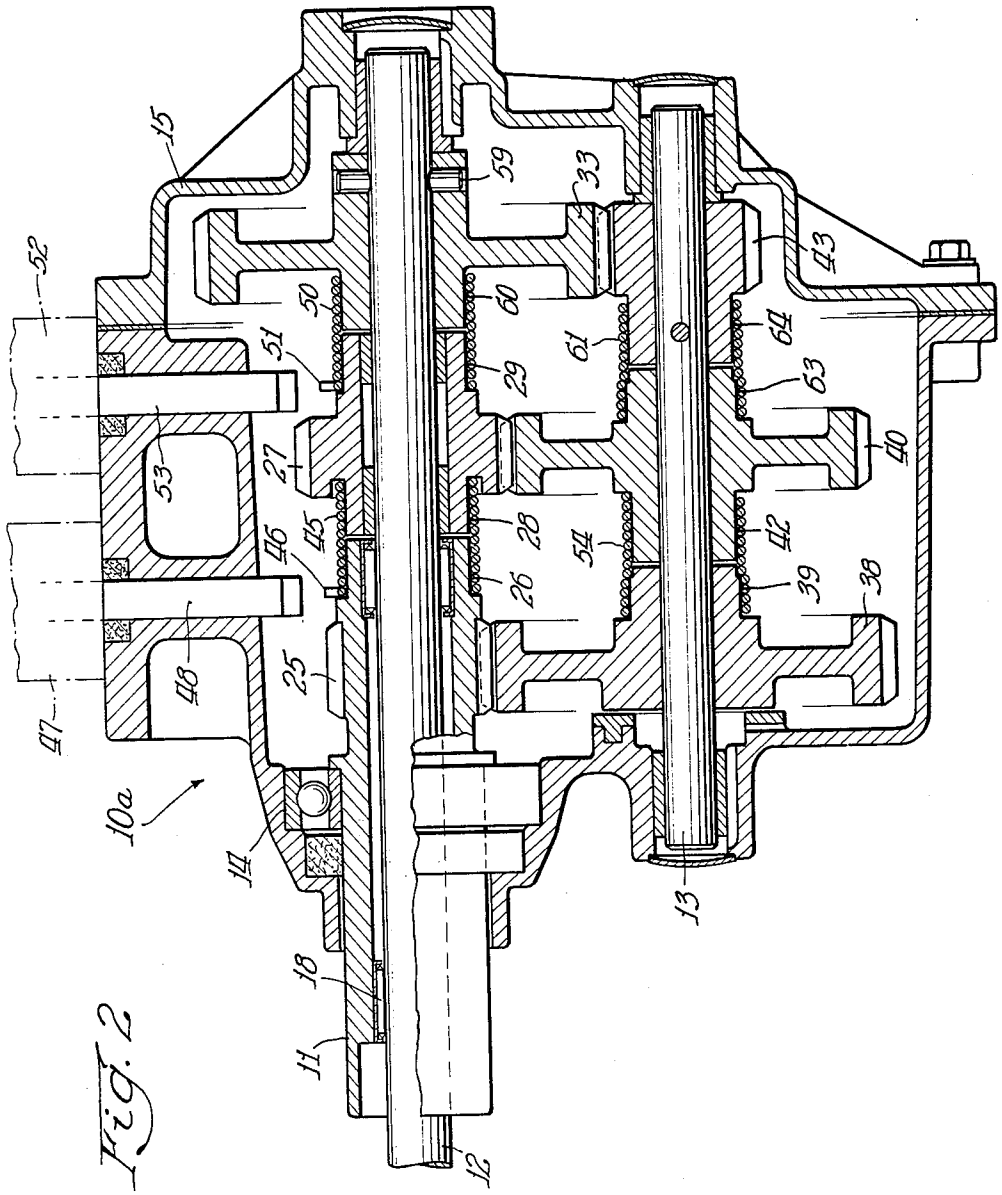


Fig. 2

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3,090,248

WASHING MACHINE MECHANISM

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10 Claims. (Cl. 74—368)

This invention relates to a transmission and more particularly to a four-speed transmission suitable for use in automatic clothes washing machines.

In the operation of automatic clothes washing machines, a single power source is used for driving the laundry basket during the entire laundering operation and includes a low speed washing cycle and a high speed spin cycle to remove the water from the laundry. A greater amount of torque is required for driving the laundry basket during the washing cycle inasmuch as the basket is heavily loaded by the combined weight of the laundry and water contained therein. Contrasted with this, a lesser torque and a higher speed is required for driving the basket during the spin cycle so as to remove the water from the basket and the clothes by centrifugal force. As the water is removed during the spin cycle, the loading on the laundry basket is continuously reduced so that the spin speed could be increased to expedite removal of the water without unduly loading the drive unit. It is therefore extremely important to be able to provide a transmission for a given drive unit which would automatically provide the necessary low speed and high torque drive for the laundry basket for washing the clothes and which could be automatically shifted through progressively higher speeds to provide a water-removing spin cycle wherein the spin speed of the laundry basket would be increased in increments as the water is removed therefrom during the spin cycle.

It is a primary object of this invention to provide a sturdy transmission of relatively simple and economical construction for providing a variable speed drive for driving the clothes basket of a clothes washing machine.

Another object of this invention is to provide a compact variable speed transmission having the input shaft positioned coaxially within the output shaft.

A further object of this invention is to provide a variable speed transmission which can be automatically actuated to provide four speeds forward.

Still another object of this invention is to provide a variable speed transmission which requires only two actuating elements for selectively providing four speeds forward.

Another object of this invention is to provide a variable speed transmission having resilient interconnecting speed control elements in the drive train thereof.

With these and other objects in view, the present invention contemplates, among other things, a variable speed transmission having the drive shaft rotatably mounted in a casing and a driven shaft coaxially rotatably mounted in the drive shaft. A series of gears are mounted coaxially on the drive shaft and are respectively in engagement with a series of gears mounted on an idler shaft which, in turn, is rotatably disposed in the casing. Actuatable and overriding spring clutches are provided adjacent predetermined gears within the casing so that four speeds forward are provided by selectively actuating the individual actuatable spring clutches.

The invention consists of the novel constructions, arrangements and devices to be hereinafter described and claimed for carrying out the above-stated objects and such other objects as will appear from the following description of an embodiment of the invention, illustrated with respect to the accompanying drawings, wherein

FIG. 1 is a sectional view of a transmission forming

a preferred embodiment of the invention, said section taken longitudinally through the shafts of the transmission and showing the interrelation of the elements of the transmission.

FIG. 2 is a sectional view of a transmission illustrating another embodiment of the invention, said section being taken longitudinally through the shafts of the transmission showing the interrelation of the elements of the transmission.

Referring to the drawings, there is illustrated a variable speed transmission which is particularly suitable for use in an automatic clothes washing machine. A preferred embodiment of the variable speed transmission is illustrated in FIG. 1 and is generally designated by the numeral **10**. The transmission includes, among other things, a drive shaft **11**, a driven shaft **12**, and an idler shaft **13**. The drive shaft **11** is rotatably mounted on a bearing **14** secured within a casing **15** and is provided with a coaxial passage **17**. The driven shaft **12** is rotatably mounted coaxially with the drive shaft **11** on bearings **18** within the passage **17** of the drive shaft **11**. The right end (FIG. 1) of the driven shaft **12** is rotatably mounted in the casing **15** at **19**, and the left end of the driven shaft **12** extends beyond the drive shaft **11** and is adapted to provide a power output portion **20**. The idler shaft **13** is rotatably mounted in the casing **15** at **21** and **22** and is positioned parallel to the drive and driven shafts **11** and **12**.

A small drive gear **25** is formed on the drive shaft **11** and is provided with a cylindrical clutch drum surface **26**. An intermediate drive gear **27** is rotatably mounted on the drive shaft **12** and is provided with a cylindrical clutch drum surface **28** adjacent the drum surface **26** of the drive gear **25**. The intermediate drive gear **27** is also provided with a cylindrical clutch drum surface **29** on the opposite side of the gear **27**. A first clutch drum **30** having a drum surface **31** is secured to the driven shaft **12** by a pin **32** and is positioned with the drum surface **31** adjacent the drum surface **29** on the intermediate drive gear **27**. A large drive gear **33** is rotatably mounted on the driven shaft **12** and is provided with a cylindrical clutch drum surface **34**. A second clutch drum **35**, having a drum surface **36**, is secured to the driven shaft **12** by a pin **37**. The second drum surface **36** is positioned adjacent the clutch drum surface **34** of the large drive gear **33**.

A large driven gear **38** is rotatably mounted on the idler shaft **13** and is in mesh with the small drive gear **25**. The large driven gear **38** is provided with a cylindrical clutch drum surface **39**. An intermediate driven gear **40** is secured to the idler shaft **13** by a pin **41** and is in mesh with the intermediate drive gear **27**. The intermediate driven gear **40** is provided with a cylindrical clutch drum surface **42** adjacent the clutch drum surface **39** of the large driven gear **38**. A small driven gear **43** is secured to the idler shaft **13** by a pin **44** and is in mesh with the large drive gear **33**.

A normally engaged, releasable, helical, spring **45** provides a clutch which is mountted on the adjacent clutch surfaces **26** and **28** of the small and intermediate drive gears **25** and **27** respectively and is in frictional engagement with the clutch surfaces **26** and **28**. The spring clutch **45** is wound in a direction so as to be self-energizing as a result of the frictional engagement between the spring **45** and the clutch surfaces **26** and **28**, during rotation of the drive gear **25**. This causes the spring clutch **45** to normally grip the clutch surfaces **26** and **28** and thereby normally effectuate a resilient drive connection between the small and intermediate drive gears **25** and **27**. The spring clutch **45** is provided with a laterally extending end portion **46** which, when held stationary dur-

ing rotation of the drive gear **25**, will cause the spring clutch to release its self-energizing gripping relation with the clutch surfaces **26** and **28**. A solenoid **47** is secured to the casing **15** and is electrically actuatable to cause a plunger **48** to move into the rotational path of the spring end **46** of the spring **45** to hold the end **45** against rotational movement and thereby effectuate disengagement of the clutch spring **45** with the surfaces **26** and **28** so as to release the resilient drive between the drive gear **25** and the intermediate drive gear **27**.

Similarly, a normally engaged, releasable, helical spring clutch **50** is positioned on the cylindrical clutch drum surfaces **29** and **31** of the intermediate drive gear **27** and the clutch drum **30** respectively and is in frictional engagement with the clutch drum surfaces **29** and **31**. The spring clutch **50** is wound in a direction so as to be self-energizing as a result of the frictional engagement between the clutch spring **50** and the clutch surfaces **29** and **31** during rotation of the intermediate gear **27**. This causes the spring clutch **50** to normally grip the clutch surfaces **29** and **31** and thereby normally effectuate a resilient drive connection between the intermediate drive gear **27** and the driven shaft **12** during rotation of the intermediate drive gear **27**.

The spring clutch **50** is provided with a radially extending end portion **51** which when held stationary will cause the disengagement of the spring clutch **50** with the clutch drum surfaces **29** and **31**. A solenoid **52** is secured to the casing **15** and is electrically actuatable to cause a plunger **53** to move into the rotational path of the spring end **51** of the spring clutch **50** to hold the end **51** against rotational movement and thereby effectuating disengagement of the clutch spring **50** with the surfaces **29** and **31** so as to release the resilient drive between the intermediate drive gear **27** and the driven shaft **12**.

A normally engaged, overriding, helical, spring clutch **55** is positioned on the cylindrical clutch drum surface **34** of the large drive gear **33** and the cylindrical clutch drum surface **36** of the clutch drum **35** on the driven shaft **12**. The spring clutch **55** is in frictional contact with the clutch drum surfaces **34** and **36** so as to normally provide a resilient self-energizing connection between the large drive gear **33** and the driven shaft **12**. The overriding spring clutch **55** is wound in a direction such that it will be caused to disengage when the speed of the driven shaft **12** exceeds that of the large drive gear **33**. The driven shaft **12** is thereby permitted to exceed the speed of the large drive gear **33**.

Similarly, a normally engaged, helical, overriding, spring clutch **54** is positioned on the cylindrical clutch drum surfaces **39** and **42** of the large and intermediate driven gears **38** and **40**. The overriding spring clutch **54** is wound in a direction such that it is self-energizing so as to normally grip the drum surfaces **39** and **42** and provide a resilient driving connection between the large and intermediate driven gears **38** and **40**. The direction of the windings of the overriding spring clutch **54** are such that when the speed of the intermediate driven gear **40** exceeds the speed of the large driven gear **38** the spring clutch **54** will be caused to disengage from the clutch drum surfaces **39** and **42** and thereby allow an overriding relationship between the intermediate and large driven gears **40** and **38**.

In operation, the transmission **10** (FIG. 1) is adapted to provide four speeds forward including a low speed for driving the laundry basket under the heavy load of a washing cycle. Also, three additional speeds are provided for spinning the laundry basket at increased speed increments so that as the water is removed by the spinning action, the spin speed may be increased.

The transmission **10** is conditioned for first speed by actuating the solenoids **47** and **52** which in turn will move the plungers **48** and **53** into the path of the ends **46** and **51** of springs so as to cause the disengagement of the helical clutch springs **45** and **50** respectively. As a result of the disengagement of the spring clutches **45** and **50**

the first speed drive is completed through the small drive gear **25**, the large driven gear **38** and the intermediate driven gear **40** by virtue of the normally engaging helical clutch spring **54**, the idler shaft **13**, the small driven gear **43**, the large drive gear **33**, the cylindrical drum **35** by virtue of the normally engaged overriding spring clutch **55** and out through the driven shaft **12**.

A second speed is obtained by actuating the solenoid **52** only so as to cause the plunger **53** to engage the spring end **51** of the spring clutch **50** and thereby release the spring clutch **50** from a normally engaged driving relation between the intermediate and the large drive gears **27** and **33** respectively. The second speed gear ratio is thereupon provided through the small drive gear **25** and the intermediate drive gear **27** by virtue of the normally actuated helical spring clutch **45**, the intermediate driven gear **40**, the idler shaft **13**, the small driven gear **43**, the large drive gear **33**, and out through the driven shaft clutch **12** by virtue of the normally actuated helical spring clutch **55** interconnecting the large drive gear **33** and the clutch drum **35**. It should be noted that the spring clutch **54** will release so as to allow an overriding relation between the large and intermediate driven gears **38** and **40**.

A third speed is provided by actuating the solenoid **47** only so as to cause the plunger **48** to engage the spring end **46** of the normally engaged helical spring clutch **45** and thereby release the clutch spring **45**. The third speed is thereupon provided through the small drive gear **25**, the large driven gear **38** and the intermediate driven gear **40** by virtue of the normally engaged spring clutch **54**, the intermediate drive gear **27** and the first clutch drum **30** by virtue of the normally engaged spring clutch **50**, and out through the driven shaft **12**. It should be noted that the spring clutch **55** will release so as to allow an overriding relation between the large drive gear **33** and the driven shaft **12**.

The fourth speed is provided when neither of the solenoids **47** or **52** are actuated and both of the releasable helical spring clutches **45** and **50** are thereby allowed to exert their normal resilient connection between the small and intermediate drive gears **25** and **27** and the intermediate and large drive gears **27** and **33** respectively. The fourth speed is thereupon provided through the small drive gear **25** and the intermediate drive gear **27** by virtue of the normally engaged releasable spring clutch **45**, the intermediate drive gear **27** and the clutch drum **30** by virtue of the normally releasable spring clutch **50**, and out through the driven shaft **12**. It should be noted that the spring clutch **54** will release so as to provide an override relation between the large and intermediate driven gears **38** and **40** respectively. Also, clutch springs **55** will release so as to provide an override relation between the large drive gear **33** and the driven shaft **12**.

A tabulation is provided below which graphically indicates which of the friction devices are engaged or disengaged for each of the four speed ratios above described in reference to the transmissions illustrated in FIG. 1. It should be noted that the gear ratios indicated in the tabulation are the approximate ratios provided by a particular embodiment of the invention and in no way restrict the invention to a specific arrangement or construction.

Gear	Clutches Engaged	Clutches Disengaged	Ratio
1	54 and 55	45 and 50	8.5
2	45 and 55	50 and 54	4.7
3	50 and 54	45 and 55	1.8
4	45 and 50	54 and 55	1.0

It should be noted that the preferred embodiment of the invention, as above described, provides a four speed washing machine transmission which includes a low speed drive for driving the laundry basket during the washing

cycle, and three higher speeds for spinning the laundry to remove the water with increasing speed as the water is removed. Further, it should be noted that the four speeds may be selectively provided by individual, remote, electric actuation of only two solenoids. Also, it should be noted that the drive shaft is coaxial with the driven shaft and that all clutch drive connections are resilient.

Another embodiment of the invention (FIG. 2) illustrates a transmission, generally referred to by the numeral **10***a*, which is similar to the embodiment shown in FIG. 1 and it should be noted that like numbers refer to like elements of the respective embodiments illustrated in FIGS. 1 and 2. However, the transmission **10***a* (FIG. 2) illustrated does not utilize the overriding helical spring clutch **55**, the pins **32** and **41** and the clutch drums **30** and **35**. Instead a pin **59** is provided to secure the large drive gear **33** to the driven shaft **12**. The large drive gear **33** is provided with a clutch drum **60** positioned within the clutch spring **50**. Also, an overriding spring clutch **61** is mounted on a cylindrical clutch drum surface **63** formed on the intermediate driven gear **40** and on an adjacent cylindrical clutch drum surface **64** formed on the small driven gear **43**.

The spring clutch **61** is a self-energizing overriding clutch spring which reacts with the drum surfaces **63** and **64** to provide a resilient connection between the intermediate and small driven gears **40** and **43**. Inasmuch as the spring clutch **61** is an overriding clutch spring, the small driven gear **43** will override the intermediate driven gear **40** when the small driven gear **43** is driven by the large drive gear **33**.

In operation, the transmission **10***a* (FIG. 2) is adapted to provide four speeds forward including a low speed for driving the laundry basket under the heavy load of a washing cycle. Also, three additional speeds are provided for spinning the laundry basket at increased speed increments so that as the water is removed by the spinning action, the spin speed may be increased.

The transmission **10***a* is conditioned for first or low speed by actuating the solenoids **47** and **52** which in turn will move the plungers **48** and **53** into the path of the ends **46** and **51** of the clutch springs **45** and **50** respectively so as to cause disengagement of the helical spring clutches **45** and **50**. As a result of the disengagement of the spring clutches **45** and **50** the first speed drive is completed through the small drive gear **25**, the large driven gear **38** and the intermediate driven gear **40** by virtue of the normally engaged helical spring clutch **54**, the intermediate driven gear **40** and the small driven gear **43** by virtue of the normally engaged helical spring clutch **61**, the large drive gear **33**, and out through the driven shaft **12**.

A second speed is obtained by actuating the solenoid **52** only so as to cause the plunger **53** to engage the spring end **51** of the spring clutch **50** to release the spring clutch **50** from a normally engaged driving relation between the intermediate and large drive gears **27** and **33** respectively. The second speed gear ratio is thereupon provided through the small drive gear **25** and the intermediate drive gear **27** by virtue of the normally actuated helical spring clutch **45**, the intermediate drive gear **40** and the small driven gear **43** by virtue of the normally actuated spring clutch **61**, the large drive gear **33**, and out through the driven shaft **12**. It should be noted that the spring clutch **54** will release so as to allow an override between the intermediate and large driven gears **38** and **40**.

A third speed is provided by actuating the solenoid **47** only so as to cause the plunger **48** to engage the spring end **46** of the normally engaged helical spring **45** to release the spring clutch **45**. The third speed is thereby provided through the small drive gear **25**, the large driven gear **38** and the intermediate driven gear **40** by virtue of the normally engaged overriding spring clutch **54**, the intermediate driven gear **27** and the large drive gear **33** by virtue of the normally engaged releaseable clutch spring **50**, and out through the driven shaft **12**. It should be noted that the clutch spring **61** will release so as to allow an override relation between the small driven gear **43** and the intermediate driven gear **40**.

The fourth speed gear ratio is provided when neither of the solenoids are actuated and both of the releasable springs **45** and **50** are thereby allowed to assert their normal resilient connection between the small and intermediate drive gears **25** and **27** and between the intermediate and large drive gears **27** and **33** respectively. The fourth speed is thereby provided through the small drive gear **25** and the intermediate drive gear **27** by virtue of the normally engaged releasable spring clutch **45**, through the intermediate drive gear **27** and the large drive gear **33** by virtue of the normally engaged releasable spring clutch **50** and out through the driven shaft **12**. It should be noted that the spring clutches **54** and **61** will release so as to provide an overriding relation between the intermediate and large driven gears **40** and **38** respectively, and between the small and intermediate driven gears **43** and **40**, respectively.

A tabulation is provided below which graphically indicates which of the friction devices are engaged or disengaged for each of the four speed ratios above described in reference to the transmission illustrated in FIG. 2. It should be noted that the gear ratios indicated in the tabulation are the approximate relations provided by a particular embodiment of the invention and in no way restrict the invention to a specific arrangement or construction.

Gear	Clutches Engaged	Clutches Disengaged	Ratio
1	54 and 61	45 and 50	8.0
2	45 and 61	50 and 54	5.5
3	50 and 54	45 and 61	1.5
4	45 and 50	54 and 61	1.0

It should be noted that the embodiment of the invention as above described and as illustrated in FIG. 2 similarly provides a four speed washing machine transmission which includes a low speed drive for driving the laundry basket during the washing cycle and three higher speeds for spinning the laundry to remove the water with increasing speed as the water is removed. Further, it should be noted that the four speeds are selectively provided by remote electric actuation of only two solenoids. Also, it should be noted that the drive shaft is coaxial with the driven shaft and that the clutch drive connections are resilient.

I wish it to be understood that the invention is not to be limited to the specific constructions and arrangements shown and described, except only insofar as the claims may be so limited, as it will be understood to those skilled in the art that changes may be made without departing from the principles of the invention.

What is claimed is:

1. In a variable speed transmission comprising a casing, a drive shaft rotatably mounted in said casing, a driven shaft element rotatably mounted in said casing and coaxially within said drive shaft, an idler shaft element rotatably mounted in said casing parallel to said drive shaft, first, second, and third drive gear elements coaxially mounted on said driven shaft, said first drive gear element being rotatable with said drive shaft, first, second, and third driven gear elements coaxially mounted on said idler shaft in meshing engagement with said first, second, and third drive gear elements respectively, first and second self-engaging overrunning clutches for providing driving interconnections between four elements of the transmission and adapted to disengage in response to

overrunning tendency between the elements normally interconnected thereby, first and second self-engaging releasable clutches for providing driving interconnections between four remaining elements of the transmission and adapted to be selectively actuated for providing four speeds forward, and means for selectively actuating said releasable clutches.

2. In a variable speed transmission comprising a casing, a drive shaft element rotatably mounted in said casing, a driven shaft element rotatably mounted in said casing and coaxially within said drive shaft, an idler shaft element rotatably mounted in said casing parallel to said drive shaft, first, second and third drive gear elements coaxially mounted on said driven shaft, said first drive gear element being rotatable with said drive shaft, first, second, and third driven gear elements coaxially mounted on said idler shaft in meshing engagement with said first, second, and third drive gear elements respectively, first and second self-engaging overrunning helical spring clutches for providing driving interconnections between four elements of the transmission and adapted to disengage in response to overrunning tendency between any two of the elements normally interconnected thereby, first and second self-engaging releasable helical spring clutches for providing driving interconnections between the four remaining elements of the transmission and adapted to be selectively actuated for providing four speeds forward, and means for selectively actuating said releasable clutches.

3. In a variable speed transmission comprising a casing, a drive shaft rotatably mounted in said casing, a driven shaft rotatably mounted in said casing and coaxially within said drive shaft, an idler shaft rotatably mounted in said casing parallel to said drive shaft, a first drive gear formed on said drive shaft, second and third drive gears rotatably mounted on said driven shaft, a first driven gear rotatably mounted on said idler shaft, second and third driven gears secured to said idler shaft, said driven gears being respectively in mesh with said drive gears, a first releasable self-engaging clutch mounted on said first and second drive gears for releasably interconnecting said first and second drive gears, a second releasable self-engaging clutch releasably interconnecting said second drive gear with said driven shaft, a first overrunning self-engaging clutch interconnecting said drive gear and said driven shaft, a second overrunning self-engaging clutch for interconnecting said first and second driven gears, and means for independently releasing said first and second self-engaging clutches to provide four forward speeds between said drive and said driven shafts.

4. In a variable speed transmission comprising a casing, a drive shaft rotatably mounted in said casing, a driven shaft rotatably mounted in said casing and coaxially within said drive shaft, an idler shaft rotatably mounted in said casing parallel to said drive shaft, a first drive gear formed on said drive shaft, second and third drive gears rotatably mounted on said driven shaft, a first driven gear rotatably mounted on said idler shaft, second and a third driven gears secured to said idler shaft, said driven gears being respectively in mesh with said drive gears, a first normally engaged releasable helical spring clutch mounted on said first and second drive gears for releasably interconnecting said gears, a second normally engaged releasable helical spring clutch mounted on said second drive gear and said driven shaft for releasably connecting said gear with said shaft, a first overrunning normally engaged helical spring clutch mounted on said third drive gear and said driven shaft for interconnecting said gear and said shaft, a second overrunning normally engaged helical spring clutch mounted on said first driven gear and said second driven gear for itnerconnecting said gears, and means for independently releasing said first and second normally engaged spring clutches to provide four forward speeds between said drive and said driven shafts.

5. In a variable speed transmission comprising a casing, a drive shaft rotatably mounted in said casing, a driven shaft rotatably mounted in said casing and coaxially within said drive shaft, an idler shaft rotatably mounted in said casing parallel to said drive shaft, a first drive gear formed on said drive shaft, second and third drive gears rotatably mounted on said driven shaft, a first driven gear rotatably mounted on said idler shaft, second and third driven gears secured to said idler shaft, said driven gears being respectively in mesh with said drive gears, clutch drum surfaces provided by adjacent sides of said first and second drive gears, adjacent clutch drum surfaces provided by the second drive gear and said drive shaft, adjacent clutch drum surfaces provided by said third drive gear and said driven shaft, clutch drum surfaces provided by adjacent sides of said first and second driven gears, a first self-engaging releasable spring mounted on said first and second drive gear clutch drums for releasably interconnecting said gears, a second self-engaging releasable spring mounted on said second drive gear and said driven shaft drum surfaces for releasably interconnecting said gear with said shaft, a first overrunning self-engaging spring mounted on said third drive gear clutch drum surface and said adjacent driven shaft clutch drum surface for interconnecting said gear and said shaft, a second overrunning self-engaging spring mounted on said first driven gear clutch drum surface and said second driven gear clutch drum surface for interconnecting said gears and, means for independently releasing said first and second releasable self-engaging springs to provide four forward speeds between said drive and said driven shafts.

6. In a variable speed transmission comprising a casing, a drive shaft rotatably mounted in said casing, a driven shaft rotatably mounted in said casing and coaxially within said drive shaft, an idler shaft rotatably mounted in said casing parallel to said drive shaft, a first drive gear formed on said drive shaft, second and third drive gears rotatably mounted on said driven shaft, a first driven gear rotatably mounted on said idler shaft, second and third driven gears secured to said idler shaft, said driven gears being respectively in mesh with said drive gears, clutch drum surfaces provided by adjacent sides of said first and second drive gears, adjacent clutch drum surfaces provided by the second drive gear and said drive shaft, adjacent clutch drum surfaces provided by said third drive gear and said driven shaft, clutch drum surfaces provided by adjacent sides of said first and second driven gears, a first normally engaged releasable helical spring mounted on said first and second drive gear clutch drums for releasably interconnecting said gears, a second normally engaged releasable helical spring mounted on said second drive gear and said driven shaft for releasably connecting said gear with said shaft, a first overrunning normally engaged helical spring mounted on said third drive gear cdlutch drum and said adjacent driven shaft clutch drum for interconnecting said gear and said shaft, a second overrunning normally engaged helical spring mounted on said first driven gear clutch drum and said second driven gear clutch drum for interconnecting said gears, and means for independently releasing said first and second normally engaged springs to provide four forward speeds between said drive and said driven shafts.

7. In a variable speed transmission comprising a casing, a drive shaft rotatably mounted in said casing, a driven shaft rotatably mounted in said casing and coaxilly within said drive shaft, an idler shaft rotatably mounted in said casing parallel to said drive shaft, a first drive gear formed on said drive shaft, a second drive gear rotatably mounted on said driven shaft, a third drive gear secured to said driven shaft, first and second driven gears rotatably mounted on said idler shaft, a third driven gear secured to said idler shaft, said first, second, and third driven gears being respectively in mesh with said first second and third drive gears, a first self-engaging releasable clutch mounted on said first and second drive gears for releasably interconnecting said first and second drive gears, a second self-engaged releasable clutch mounted

on said second and third drive gears for releasably interconnecting said second and third drive gears, a first overrunning self-engaged clutch mounted on said first and second driven gears for interconnecting said first and second driven gears, a second overrunning self-engaging clutch mounted on said second and third driven gears for interconnecting said second and third driven gears, and means for independently releasing said first and second self-engaging releasable clutches to provide four forward speeds between said drive and said driven shafts.

8. In a variable speed transmission comprising a casing, a drive shaft rotatably mounted in said casing, a driven shaft rotatably mounted in said casing and coaxially within said drive shaft, an idler shaft rotatably mounted in said casing parallel to said drive shaft, a first drive gear formed on said drive shaft, a second drive gear rotatably mounted on said driven shaft, a third drive gear secured to said driven shaft, first and second driven gears rotatably mounted on said idler shaft, a third driven gear secured to said idler shaft, said first, second, and third driven gears being respectively in mesh with said first, second, and third drive gears, a first normally engaged releasable helical spring clutch mounted on said first and second drive gears for releasably interconnecting said first and second drive gears, a second normally engaged releasable helical spring clutch mounted on said second and third drive gears for releasably interconnecting said second and third drive gears, a first overrunning normally engaged helical spring clutch mounted on said first and second driven gears for interconnecting said first and second driven gears, a second overrunning normally engaged helical spring clutch mounted on said second and third driven gears for interconnecting said second and third driven gears, and means for independently releasing said first and second normally engaged spring clutches to provide four forward speeds between said drive and said driven shafts.

9. In a variable speed transmission comprising a casing, a drive shaft rotatably mounted in said casing, a driven shaft rotatably mounted in said casing and coaxially within said drive shaft, an idler shaft rotatably mounted in said casing parallel to said drive shaft, a first drive gear formed on said driven shaft, a second drive gear rotatably mounted on said driven shaft, a third drive gear secured to said driven shaft, first and second driven gears rotatably mounted on said idler shaft, a third driven gear secured to said idler shaft, said first, second, and third driven gears being respectively in mesh with said first, second, and third drive gears, clutch drum surfaces provided by adjacent sides of said first and second drive gears and said second and third drive gears, clutch drum surfaces provided by adjacent sides of said first and second driven gears and said second and third gears, a first self-engaging releasable spring mounted on said first and second drive gear clutch drums for releasably interconnecting said first and second drive gears, a second self-engaging releasable spring mounted on said second and third drive gear clutch drums for releasably interconnecting said second and third drive gears, a first overrunning self-engaging spring mounted on said first and second driven gear clutch drums for interconnecting said first and second driven gears, a second overrunning self-engaging spring mounted on said second and third driven gear clutch drums for interconnecting said second and third driven gears, and a means for independently releasing said first and second self-engaging releasable springs to provide four forward speeds between said drive and said driven shafts.

10. In a variable speed transmission comprising a casing, a drive shaft rotatably mounted in said casing, a driven shaft rotatably mounted in said casing and coaxially within said drive shaft, an idler shaft rotatably mounted in said casing parallel to said drive shaft, a first drive gear formed on said drive shaft, a second drive gear rotatably mounted on said driven shaft, a third drive gear secured to said driven shaft, first and second driven gears rotatably mounted on said idler shaft, a third driven gear secured to said idler shaft, said first, second, and third driven gears being respectively in mesh with said first, second, and third drive gears, clutch drum surfaces provided by adjacent sides of said first and second drive gears and said second and third drive gears, clutch drum surfaces provided by adjacent sides of said first and second driven gears and said second and third driven gears, a first normally engaged releasable helical spring mounted on said first and second drive gear clutch drums for releasably interconnecting said first and second drive gears, a second normally engaged releasable helical spring mounted on said second and third drive gear clutch drums for releasably interconnecting said second and third drive gears, a first overrunning normally engaged helical spring mounted on said first and second driven gear clutch drums for interconnecting said first and second driven gears, a second overrunning normally engaged helical spring mounted on said second and third driven gear clutch drums for connecting said second and third driven gears, and means for independently releasing said first and second normally engaged springs to provide four forward speeds between said drive and said driven shafts.

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