July 5, 1949. F. L. EATON, JR., ET AL 2,475,486

POWER TRANSMISSION MECHANISM FOR SPINNING MULES

Filed May 24, 1947

2 Sheets-Sheet 1

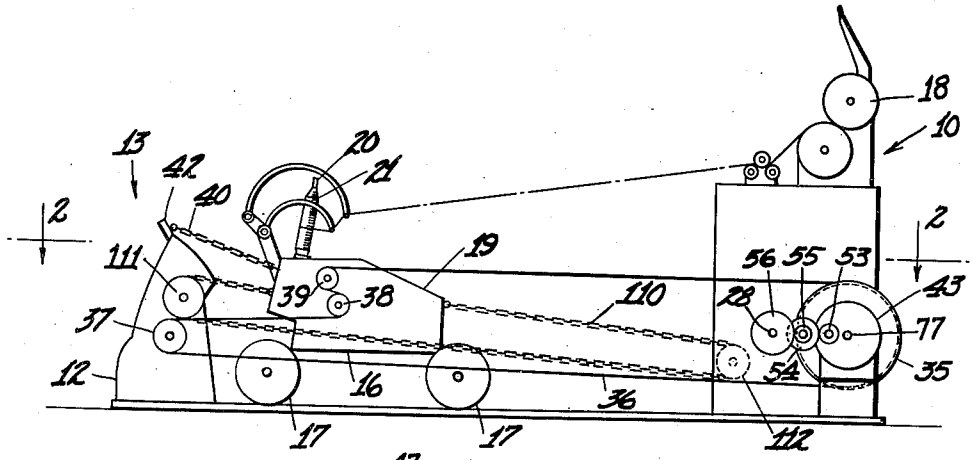

Fig. 1.

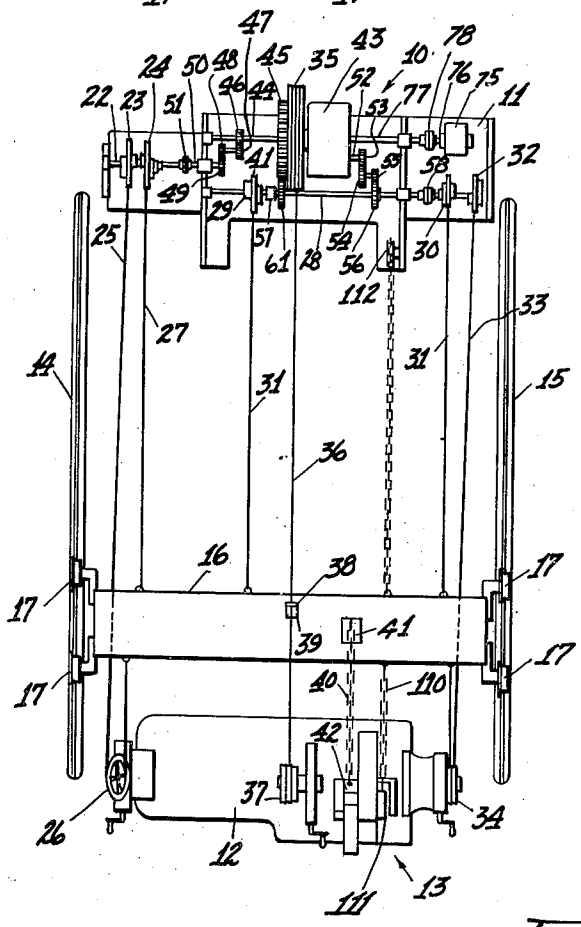

Fig. 2.

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2 Sheets-Sheet 2

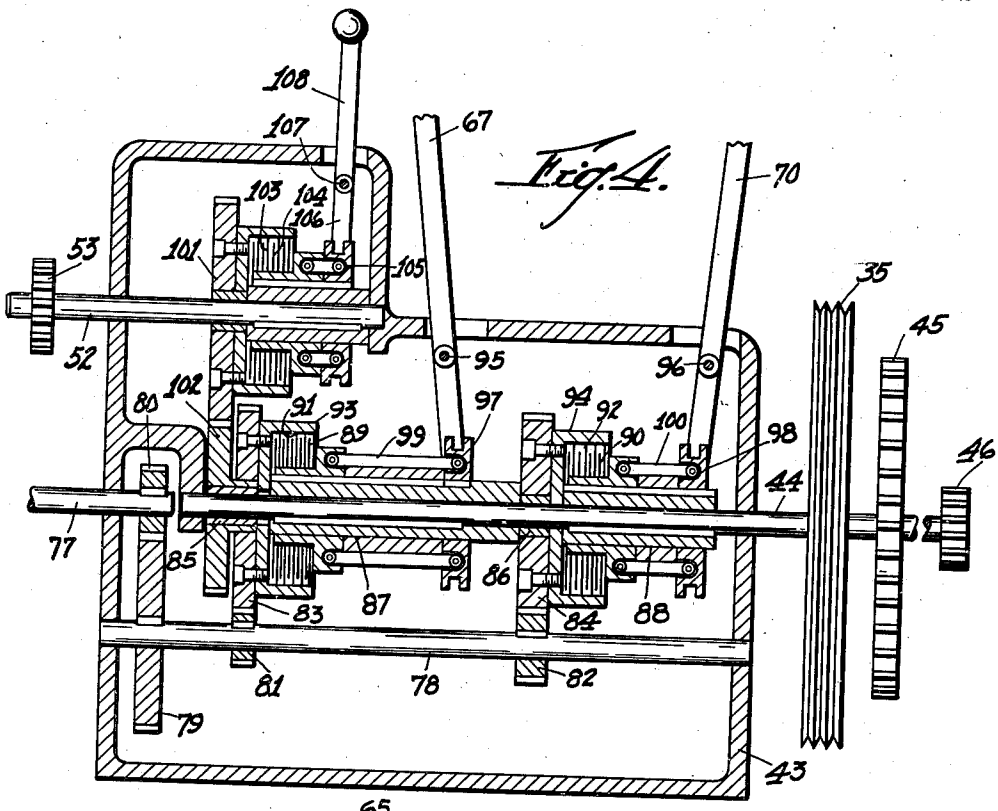

Fig. 4.

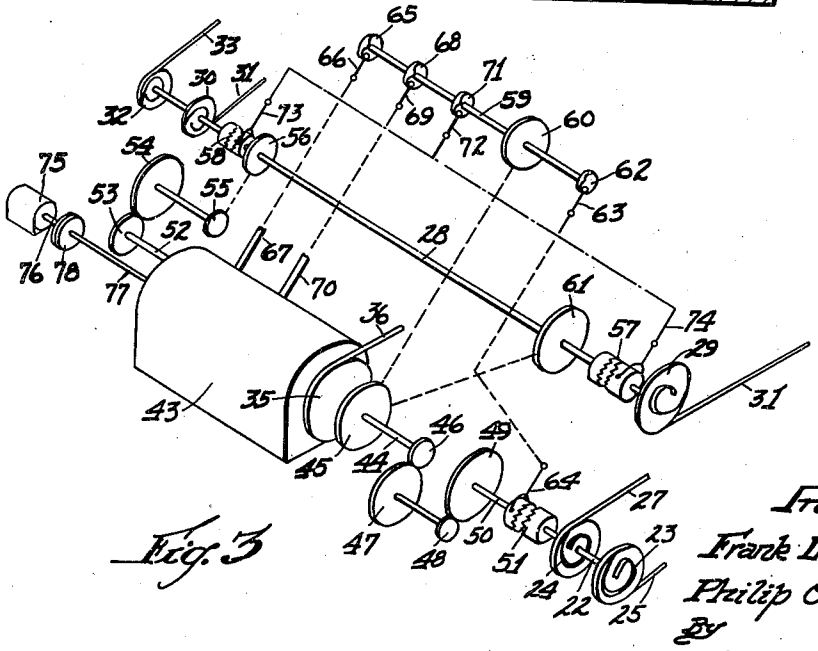

Fig. 3

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POWER TRANSMISSION MECHANISM FOR SPINNING MULES

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14 Claims. (Cl. 57—40)

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The present invention relates to spinning machines and more particularly to that type of spinning machine which is known as a self-operating mule.

As is known by those skilled in the art, a spinning machine of the self-operating mule type comprises a head mechanism, a quadrant mechanism and a carriage which is adapted to travel back and forth between the head and quadrant mechanisms. The carriage supports a center mechanism upon which the rotary spindles are mounted. All motions of the various elements comprising a mule originate in the head mechanism and in all such spinning machines heretofore used the head mechanism has been driven from a power source, such as an electric motor, which has usually been connected to the head by means of a plurality of endless belts. Various belt shipping devices have also been necessary equipment on such prior machines in order to ship the belt over various pulley combinations to the end that the mule may perform its diverse operations at the requisite speeds. It has been found that the above described power transmitting system is inherently inefficient for the reason that the belts must be maintained under a high degree of tension at all times or otherwise the belts would slip relative to the pulleys and thus cause the machine to operate unevenly. By maintaining the belts under a constant high degree of tension it follows that the pulley and shaft bearings would be placed under high loads to the end that excessive wear would result. Also, the use of such belts has been objected to by many machine owners for the reason that the belts are space-consuming and are a constant source of danger to the operating personnel.

It is, therefore, a primary object of the present invention to provide a spinning mule with a gear-driven power transmission means which will obviate the objectionable features inherent in the spinning mules which have been heretofore employed and which objectionable features have been hereinabove noted.

A further object of the present invention is to provide a spinning mule with a self-contained head mechanism.

A still further object of the present invention is to provide a spinning mule with a self-contained head mechanism which will be positively driven at all times.

With the above and other objects in view, as will hereinafter appear, the invention comprises the devices, combinations and arrangements of parts described in connection with the accompanying drawings which illustrate a preferred embodiment of the invention in which:

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Fig. 1 represents a side elevation view of a mule spinning machine incorporating the present invention therein.

Fig. 2 represents a top plan sectional view taken substantially along the line 2—2 of Fig. 1.

Fig. 3 is a diagrammatic illustration of the head mechanism incorporating therein the present invention.

Fig. 4 represents a sectional side elevation view of a transmission mechanism which forms a part of the present invention.

As is well known in the art, the spinning of yarns is accomplished by the following operation on the mule. The soft roving as it comes from a card is drawn out to reduce the diameter of the strand. Simultaneously with the drawing out of the strand the roving is twisted to give the yarn sufficient strength so that it may be properly woven. After the yarn is so twisted it is wound into a cop in a form suitable for weaving. On the usual type of machine the yarn is wound onto a bobbin or tube depending upon the requirements of the weaver.

Referring particularly to Figs. 1 and 2 of the present drawings, the mule spinning mechanism comprises in general a head mechanism designated generally by the numeral 10, which head mechanism is secured to a head plate 11 which in turn is secured directly to the floor. Spaced from the head mechanism 10 is a quadrant plate 12 upon which the usual quadrant mechanism 13 is supported. Disposed between the head and quadrant plates 11 and 12 are a pair of parallel tracks 14 and 15 upon which a carriage 16 is adapted to be guided. Such a carriage is usually provided with a plurality of wheels 17, 17 at either end thereof for the purpose of engaging the tracks 14 and 15.

Mounted upon the head mechanism in the usual manner are drawing rolls 18 which are driven in the usual manner from the mechanism contained within the head. The carriage 16 supports the usual center mechanism 19 which in turn carries a plurality of spindles 20 upon each of which is carried the usual bobbin 21.

As is well known in the art of spinning, the carriage 16 is initially placed adjacent to the delivery rolls 18. As the rolls start to deliver the roving, the carriage moves out toward the quadrant mechanism at substantially the same speed as the roving is delivered. When the carriage, with its spindles 20, 20 reaches a predetermined position, which is normally determined by the nature of

the stock to be spun, the rolls stop and the carriage continues to move toward the quadrant mechanism. By this operation the roving is thereby drawn out about twice its original length.

During this initial movement of the carriage a certain amount of twist is introduced into the roving. This twisting is accomplished by rotating the bobbins in such a manner that the rovings are not wound thereupon but are merely twisted about their longitudinal axes. As is understood by those skilled in the art, this twisting is accomplished by inclining the various bobbins toward the head mechanism and thus the rovings will not be wound thereon but will merely slip over the top of each spindle. One twist of 360° is, therefore, put into the roving for every revolution of a spindle. The combined drafting and twisting action of the mule imparts to the thread its characteristic formation.

When the carriage 16 has reached the end of the draft it is stopped and while in that position additional twist is put into the yarn thereby to give the yarn greater strength. In order to impart the additional twists to the yarn while the carriage is thus stationary adjacent the quadrant, an accelerated speed is imparted to the spindles. After this twisting is completed, the spindles reverse for a few turns, thereby performing what is known as the "back off." Thereafter the faller fingers begin to function and thereby guide the yarn onto the bobbins in a manner well known. The carriage then commences to move back toward the head mechanism 10 in order to perform the so-called "draw-in" motion. During this "draw-in" motion the faller fingers are ascending and decending thereby to guide the yarn onto the bobbins in the usual fashion. As soon as the carriage 16 has returned to its initial position the mule has then completed a full cycle and is free to perform succeeding cycles.

Referring particularly to Fig. 2, the head mechanism is provided with a draft or draw-out shaft 22 upon which are mounted a pair of draft scrolls 23 and 24. The draft scroll 23 has trained thereabout a cable 25 which extends from the scroll so as to be trained over an idler pulley 26, and thereafter the cable reverses its direction and is secured directly to the carriage 16. Trained over the scroll 24 is a second cable or draft check 27 which extends from the scroll to have one end thereof directly secured to the carriage 16. As will be hereinafter described, the head mechanism 10 is provided with power means whereby the scrolls 23 and 24 are driven in a manner such that the cable 25 will be effective to move the carriage from its initial position adjacent the head mechanism to its secondary position adjacent the quadrant. The draft check cable 27 functions to prevent the carriage 16 from overrunning during the drafting operation.

Also provided on the head mechanism 10 is a draw-in shaft 28 which may be directly connected to a pair of oppositely disposed draw-in scrolls 29 and 30 by clutching means which will be hereinafter described. Each of the draw-in scrolls 29 and 30 has one end of a cable 31 trained thereabout and the other end of the cable is connected directly to the carriage 16. Appropriate mechanism is provided in the head for clutching the scrolls 29 and 30 to the shaft 28 and thereafter rotating the shaft so as to return the carriage 16 to its initial position adjacent the head mechanism 10. It is also to be understood that on one end of the shaft 28 is mounted a draw-in check scroll 32 which is provided with a check cable 33 of which one end portion is trained about a loose pulley 34 which in turn is mounted upon the quadrant plate 12. The one end portion of the cable 33 extends from the pulley 34 to be secured directly to the carriage 16 for the purpose of preventing the same from overrunning during the draw-in portion of the mule cycle.

Referring particularly to Figs. 1 and 2, the head mechanism 10 is provided with a main rim 35 over which is trained a spindle drive cable 36 which is also trained over a pulley 37 mounted upon the quadrant mechanism 13. Intermediate the main rim 35 and the pulley 37 the cable 36 is trained about a pair of pulleys 38 and 39 which are rotatably mounted upon the center mechanism 19. Appropriate power means are provided in the head mechanism for driving the main rim 35 during the drafting operation and it is the function of the cable 36 to power, during this portion of the cycle, the spindles 20 which are connected by mechanism, not herein disclosed, to the pulleys 38 and 39.

As is understood by those skilled in the art, the spindles 20 are not rotated by means of the cable 36 during the draw-in operation at which time the carriage 16 is moved from the quadrant 13 to the head mechanism 10. However, during this portion of the cycle the spindles are rotated by a secondary means. As is well known, the secondary means comprises a quadrant arm 42 to which one end of a quadrant-winding chain 40 is secured. The other end of which chain is trained about a drum 41 rotatably mounted upon the center mechanism 19. Appropriate mechanism is provided for connecting the drum 41 to the spindles 20 during the draw-in portion of the cycle. Thus, as the carriage 16 moves from the quadrant 13 to the head mechanism 10, the quadrant arm 42 causes, by way of the chain 40, a rotation of the pulley 41 thereby to actuate the spindles 20, 20 in the usual manner.

In order properly to regulate the speed of rotation of the spindles during this draw-in operation, the quadrant arm 42 is made to rotate towards the head mechanism by means of a quadrant sprocket chain 110. This chain 110 has one end anchored to one side of the carriage 16 from which it extends backwardly to be trained over a driving sprocket 111 and then it extends forwardly to pass about an idler sprocket 112 so as to have its other end anchored to the carriage 16. Since the driving sprocket 111 is geared in the usual manner to the quadrant arm 42, the movement of the carriage 16 back and forth will be effective to actuate the quadrant arm.

Generally speaking, the present transmission mechanism comprises a housing 43 enclosing mechanism which will be hereinafter described. Projecting through one end of the housing 43 is a variable speed output or main shaft 44 upon which the hereinabove noted main rim 35 is rigidly mounted. Spaced from the main rim 35, and, also mounted upon the main shaft 44, is a loose idler gear 45. Upon the extreme end portion of the shaft 44 is rigidly mounted a draft pinion gear 46 which is adapted to drive the draft scrolls 23 and 24 by way of a compound gear reduction unit comprising the meshing gears 47, 48, and 49; it being understood that the gear 49 is mounted upon the draft or draw-out shaft 50. A clutching mechanism 51 functions to couple and uncouple the inter-connected draft scrolls 23 and 24 to and from the gear 49. From this it is to be understood that the clutching element 51 is effective to con-

nect the draft scrolls 23 and 24 to and to disconnect them from the main shaft 44.

Extending through the other end of the housing 43 is a continuously rotating output shaft 52 upon which is mounted a driving pinion 53 which is adapted to rotate continuously the hereinabove noted draw-in shaft 28 through the medium of a compound reduction gear train comprising the gears 54, 55 and 56, the latter of which gears is connected directly to the draw-in shaft 28.

As hereinabove noted, the draw-in shaft 28 has mounted thereon the draw-in scrolls 29 and 30 as well as the check scroll 32. As may be best seen in Figs. 2 and 3, the shaft 28 is provided with a pair of draw-in clutches 57 and 58. The function of the clutch 57 is to couple the scroll 29 to and to disconnect it from the shaft 28 and, by the same token, the clutch 58 functions to connect and disconnect the scrolls 30 and 32 to and from the shaft 28 which is continuously rotated by means of the shaft 52.

From the above it is to be understood that the main rim 35, as well as all of the scroll mechanisms, are all powered from the mechanism contained within the transmission housing 43. It now becomes obvious that some means is required for controlling these various driven elements so that the mule-spinning device may perform the cycle as hereinabove described. The present invention contemplates the provision of such a control means and it takes the form of a cam shaft 59 which is mounted on the head mechanism and in parallelism with the main shaft 44 and the draw-in shaft 28. This cam shaft 59 is adapted to be rotated and for this purpose it is provided with a gear 60 which is connected therewith and which meshes directly with the idler gear 45 carried by the main shaft 44. In order to rotate the idler gear 45 there is meshing therewith a gear 61 which is fixed directly upon the continuously rotating draw-in shaft 28. Thus, it is to be understood that the cam shaft 59 may be driven from the shaft 52 through the medium of the shaft 28 and the idler gear 45.

Mounted upon one end of the cam shaft 59 is a draft cam 62 which has engaging therewith one end of a pivoted follower 63 the other end portion of which carries the usual clutch fork 64 for the purpose of engaging the draft clutch 51. It is the purpose of the draft cam 62 to so actuate the clutch 51 that the draft scrolls 23 and 24 will be intermittently operated to the end that the carriage will be moved from the head mechanism toward the quadrant whenever the draft motion is required during the spinning cycle.

Mounted upon the opposite end portion of the cam shaft 59 is a low-speed cam 65 which has engaging therewith a pivoted follower 66 the other end portion of which connects with a gear shifter 67 projecting through the transmission housing 43. It is the purpose of this cam 65 to shift the lever 67 in a manner such that the gearing, which will be hereinafter described, will be effective to produce a predetermined speed of rotation of the shaft 44 prior to and during the drafting portion of the cycle. Furthermore, this cam 65 will be effective to retain the lever 67 in that position until the carriage has completed the drafting operation, after which time the cam will be effective to throw the lever in the opposite direction thereby to permit a further gear change which will be hereinafter described.

Mounted upon the cam shaft 59 between the cam 65 and the gear 60 is a high-speed cam 68 which has engaging therewith a pivoted follower

69 the other end portion of which is adapted to be connected to a lever 70 which extends into the transmission housing 43 in a manner similar to that of the lever 67. It is the function of the lever 70 to change the gear ratio within the transmission housing 43 in such a manner that the shaft 44 will be driven at a speed substantially greater than the hereinabove noted speed which was governed by the lever 67. It is the purpose of the cam 68 to actuate the lever 70 whenever the carriage 16 is positioned adjacent the quadrant, and thus while the carriage remains stationary the shaft 44 is accelerated thereby to speed up the motions of the bobbins to the end that additional twists are placed in the yarn in a manner as hereinabove set forth. Of course, the cams 65 and 68 are so timed that the lever 70 is not actuated until after the lever 67 has been shifted in a manner such that its gear train is no longer effective to drive the shaft 44. The cam 68 also is adapted to actuate the lever 70 at that point in the spinning cycle when the carriage 16 is to be moved back toward the head mechanism 10 for, as hereinabove noted, it is at this point that the rim 35, with its cable 36, no longer functions to power the bobbins for the reason that the quadrant is adapted to rotate the bobbins upon the return motion of the carriage 16. Since, during this return motion of the carriage 16 it is not necessary to power-drive the draft scrolls 23 and 24, the entire main shaft 44 may remain at rest; it being understood that the movement of the carriage 16 will be effective to rotate the scrolls 23 and 24 through the medium of the cable 25 thereby to rewind the check cable 27 upon the scroll 24.

Mounted upon the cam shaft 59 between the cam 68 and the gear 60 is a draw-in cam 71 which has engaging therewith a pivoted follower 72 the one end portion of which is adapted to be connected to a pair of clutch actuating arms 73 and 74 which function respectively to actuate the clutches 58 and 57 which are associated with the draw-in shaft 28. As noted hereinabove, the shaft 28 is adapted to be continuously rotated and thus it is the function of the draw-in cam 71 to actuate the clutches 57 and 58 in a manner such that the draw-in scrolls 29 and 30 and the check scroll 32 will be operated at the proper point in the spinning cycle. As has already been described, the clutches 57 and 58 are adapted to couple the scrolls 29, 30 and 32 to the shaft 28 whenever it is necessary to draw the carriage 16 toward the head mechanism 10; thereby to produce the draw-in portion of the cycle. By the same token, the cam 71 will operate to disengage the scrolls 29, 30 and 32 from the shaft 28 whenever the carriage 16 has arrived in its initial position adjacent the head mechanism 10.

Thus, from the above it is to be clearly understood that the rotatable cam shaft 59 functions to interrelate all of the various operating elements to the end that a proper spinning cycle is effected.

As best shown in Figs. 2, 3 and 4, the present transmission mechanism comprises an electric motor 75 which may be bolted directly to the head plate 11. Extending from the motor 75 is a motor shaft 76 which is adapted to drive a main input shaft 77 through the medium of a hydraulic coupling device 78 which functions to prevent the mechanical shocks and vibrations inherent in a machine of this character from being transferred back to the motor 75. Furthermore, such a hydraulic coupling makes for a more efficient drive as it cushions the varying loads which are applied to the shaft 77. This shaft 77 extends into the

transmission housing 43 and is disposed in coaxial relation with the main output shaft 44. As hereinabove noted the output shaft 52 also extends into the transmission housing 43 and it is disposed in a parallel relation with the shafts 44 and 77. As best shown in Fig. 4, the transmission housing provides a counter shaft 78 extending parallel to the shaft 44 and this shaft 78 is connected to shaft 77 by a gear 79 through the medium of a meshing pinion 80. The counter shaft also carries pinions 81 and 82 which mesh with gears 83 and 84, respectively, of different diameters, with the gears 83 and 84 being freely mounted on the outside of bearings 85 and 86 that surround the shaft 44. Consequently, rotation of the input shaft 77 will cause the gears 83 and 84 to be continuously driven at different speeds independently of the shaft 44 carrying the main rim 35.

The shaft 44 has keyed thereon a pair of clutching sleeves 87 and 88 mounted adjacent the bearings 85 and 86. These sleeves 87 and 88 carry series of clutch plates 89 and 90 and these clutch plates cooperate with two other series of clutch plates 91 and 92 mounted on carriers 93 and 94 which surround the sleeves 87 and 88 respectively.

The carriers 93 and 94 are mounted on the gears 83 and 84, respectively, and the plates 91 and 92 are turnable with the carriers while at the same time being capable of axial movement thereof. Therefore, the two series of clutching plates 89, 90 and 91, 92 provide means for driving the shaft 44 from either gear 83 or 84, depending upon which set of plates are engaged under pressure.

For the purpose of operating the clutches, the transmission housing 43 provides cross shafts 95 and 96 on which are mounted the hereinabove noted levers 67 and 70 respectively. These levers 67 and 70, at their lower portions, take the form of forks that embrace clutch operating rings 97 and 98. These rings are shiftable on the sleeves 87 and 88 and carry fingers 99 and 100 for engaging the respective sets of clutch plates 89, 90 and 91, 92.

As is hereinabove noted the cams 65 and 68 are adapted to operate the levers 67 and 70, respectively, and from Fig. 4, it is to be understood that these cams will operate the levers 67 and 70 in opposite directions to engage one set of clutch plates 90 and 92 while the other set of plates 89 and 91 is disengaged. The net result is that as long as the cam shaft is continuously driven, each revolution thereof will first operate the arm 67 to engage clutching members 89 and 91 and thereby drive the shaft 44 at a relatively low speed so as to move the carriage 16 outwardly, after which the arm 70 will be moved to engage the clutching elements 90 and 92 to drive the shaft 44 at high speed with the carriage at its outer position. Thereafter, both of the arms 67 and 70 will be shifted so that the shaft 44 will no longer be driven by the motor 75.

Still referring to Fig. 4, the hereinabove noted shaft 52 extends into the housing 43 and has a gear 101 loosely mounted thereon and in mesh with a pinion 102 turnable with the gear 83. Clutching elements 103 and 104 are carried by the gear 101 and shaft 52, respectively, and these elements are operated by movement of a ring 105 shiftable by a fork 106 turnable on a cross shaft 107. An arm 108 provides means for manually operating this clutch, but normally the shaft 52 is driven continuously from the shaft 77 thereby to drive the cam shaft 59 in a continuous manner.

The present invention is described and illustrated in the accompanying drawings as being incorporated in a usual type of mule-spinning machine and thus much of the mule-spinning machine proper is not herein illustrated or described. However, it is believed that sufficient mechanism of the mule-spinning machine proper is shown so as to illustrate properly applicant's invention and it should be clear to those skilled in the art that the basic and novel combination of elements herein described and claimed may be readily applied to the diverse forms of mule-spinning machines which are employed for producing various types of products.

Thus from the above it is to be understood that the present invention does away entirely with the need for belts and belt-shifting mechanisms and provides for a most efficient positive driving means for the various elements of a mule-spinning machine.

We claim:

1. A power transmission for a mule-spinning machine comprising, an enclosed transmission housing, a constant-speed input shaft extending into said housing, a power source coupled to the exposed end portion of said input shaft, a constant-speed output shaft journaled within said housing and operatively connected with said input shaft within said housing, a variable speed output shaft extending into said housing, speed-change means located within said housing and connecting said variable-speed output shaft with said input shaft, and means including a constantly rotating unidirectional cam shaft operable from said constant speed-output shaft for controlling said speed-change means in a predetermined cycle.

2. A power transmission for a mule-spinning machine comprising a constant-speed input shaft, a power source coupled to said input shaft, a constant-speed output shaft geared to said input shaft, a variable-speed output shaft, speed-change gearing connecting said variable-speed output shaft with said input shaft, and means including a constantly rotating unidirectional cam shaft operable from said constant-speed output shaft for controlling said speed-change gearing so as to vary the speed of said variable-speed output shaft in a predetermined cycle.

3. A power transmission for a mule-spinning machine comprising, a constant-speed input shaft, a power source coupled to said input shaft, a constant-speed output shaft geared to said input shaft, a variable-speed output shaft, speed-change gears interposed between said variable-speed output shaft and said input shaft, means including a plurality of clutches for connecting said variable-speed output shaft with said input shaft by means of a selective group of said speed-change gears, and means including a constantly rotating unidirectional cam shaft operable from said constant-speed output shaft for controlling said clutches in a predetermined cycle.

4. A mule-spinning machine comprising, a reciprocable carriage, a transmission unit having a constant-speed input shaft, a power source coupled with said input shaft, a pair of output shafts forming a part of said transmission unit, means connecting each of said output shafts with said input shaft so as to be driven thereby, means for intermittently connecting said output shafts with said carriage so as to reciprocate said carriage back and forth, and means including a constantly rotating unidirectional cam shaft powered by said input shaft for controlling said last mentioned means in a predetermined cycle.

5. A mule-spinning machine comprising, a re-

ciprocable carriage, a transmission unit having a constant-speed input shaft, a power source coupled with said input shaft, a constant-speed output shaft coupled with said input shaft, a variable-speed output shaft, speed-change means connecting said variable-speed output shaft with said input shaft, means powered from said constant-speed input shaft for controlling said speed-change means so as to vary the speed of said variable-speed output shaft in a predetermined manner, means for intermittently connecting said output shafts with said carriage so as to reciprocate said carriage back and forth, and means including a constantly rotating unidirectional cam shaft geared directly with said constant-speed output shaft for controlling said last mentioned means in a predetermined cycle.

6. A mule-spinning machine comprising, a reciprocable carriage, a plurality of rotary spindles mounted upon said carriage, a transmission unit having a constant-speed input shaft, a power source coupled with said input shaft, a constant-speed output shaft connected with said input shaft, a variable-speed output shaft, speed-change means connecting said variable-speed output shaft with said input shaft, means operated by said constant-speed output shaft for controlling said speed-change means so as to vary the speed of said variable-speed output shaft, means connected with said variable-speed output shaft for rotating said spindles, and means powered by each of said output shafts for reciprocating said carriage back and forth.

7. A mule-spinning machine comprising, a reciprocable carriage, a plurality of rotary spindles mounted upon said carriage, a transmission unit having a constant-speed input shaft, a power source coupled with said input shaft, a constant-speed output shaft geared to said input shaft, a variable speed output shaft, speed-change gears interposed between said variable-speed output shaft and said input shaft, means connected with said variable speed output shaft for rotating said spindles, means including a constantly rotating unidirectional cam shaft powered by said constant-speed output shaft for connecting said variable-speed output shaft to said input shaft through selective combinations of said speed-change gears in a predetermined cycle, and means powered by each of said output shafts for reciprocating said carriage back and forth.

8. A mule-spinning machine comprising, a reciprocable carriage, a plurality of rotary spindles mounted upon said carriage, a transmission unit having a constant-speed input shaft, a power source coupled with said input shaft, a constant-speed output shaft geared to said input shaft, a variable-speed output shaft, speed-change gears interposed between said variable-speed output and said input shafts, clutch means powered by said constant-speed output shaft for connecting said variable-speed output shaft to said input shaft through selective groups of said change-gears in a predetermined cycle, means connected with said variable-speed output shaft for rotating said spindles, and means powered by each of said output shafts for reciprocating said carriage back and forth.

9. A mule-spinning machine comprising, a reciprocable carriage, a plurality of rotary spindles mounted upon said carriage, a transmission unit having a constant-speed input shaft, a power source coupled with said input shaft, a constant-speed output shaft connected with said input shaft, a variable-speed output shaft, two

sets of intermeshing gears disposed between said input and said variable-speed output shafts, each of said sets being adapted to produce a different shaft speed, a pair of clutches powered by said constant-speed output shaft, each of said clutches being associated with a respective one of said sets of gears for intermittently coupling and uncoupling said variable-speed output shaft to and from said input shaft in a predetermined cycle, means connecting said variable-speed shaft with said spindles for rotating the latter, and means including a constantly rotating unidirectional cam shaft powered by said constant-speed output shaft for intermittently connecting and disconnecting said carriage to and from each of said output shafts so as to reciprocate said carriage back and forth.

10. A mule-spinning machine comprising, a reciprocable carriage, a transmission unit having a constant-speed input shaft, a power source coupled with said input shaft, a continuously rotatable output shaft coupled with said input shaft, an intermittently rotatable output shaft, clutching means operable to connect and disconnect said intermittently rotatable output shaft to and from said input shaft, means including a constantly rotating unidirectional cam shaft powered from said continuously rotatable output shaft for actuating said clutching means in a predetermined cycle, and means including said cam shaft for intermittently connecting and disconnecting each of said output shafts to and from said carriage so as to reciprocate said carriage back and forth in a predetermined cycle.

11. A mule-spinning machine comprising, a reciprocable carriage, a plurality of rotary spindles mounted upon said carriage, a transmission unit having a constant-speed input shaft, a power source coupled with said input shaft, a continuously rotatable output shaft geared to said input shaft, an intermittently rotatable output shaft, means connected with said intermittently rotatable output shaft for rotating said spindles, clutching means powered by said continuously rotatable output shaft for connecting and disconnecting said intermittently rotatable output shaft to and from said input shaft in a predetermined cycle, and means powered by each of said output shafts for reciprocating said carriage back and forth.

12. A mule-spinning machine comprising, a reciprocable carriage, a plurality of rotary spindles mounted upon said carriage, a transmission unit having a constant-speed input shaft, a power source coupled with said input shaft, a constant-speed output shaft geared to said input shaft, an intermittently rotatable output shaft, a set of intermeshing gears disposed between said input and said intermittently rotatable output shafts, a clutch powered by said constant-speed output shaft for coupling and uncoupling said intermittently rotatable shaft to and from said input shaft through the medium of said intermeshing gears in a predetermined cycle, means connecting said intermittently rotatable shaft with said spindles for rotating the latter, and means including a constantly rotating unidirectional cam shaft powered by said constant-speed output shaft for intermittently connecting and disconnecting said carriage to and from each of said output shafts so as to reciprocate said carriage back and forth.

13. A mule-spinning machine comprising, a reciprocable carriage, a plurality of rotary spindles mounted upon said carriage, a transmission unit

having a constant-speed input shaft, a power source coupled with said input shaft, a constant-speed output shaft geared to said input shaft, carriage draw-in scrolls connectible with said constant-speed output shaft, an intermittently rotatable output shaft connectible with said input shaft, spindle-operating means connected directly with said intermittently rotatable output shaft, carriage draw-out scrolls connectible with said intermittently rotatable output shaft, and means including a constantly rotatable unidirectional cam shaft powered directly from said constant-speed output shaft for connecting and disconnecting said intermittently rotatable shaft with said input shaft and for connecting and disconnecting said scrolls to and from their respective associated output shafts in a predetermined cycle.

14. A mule-spinning machine comprising, a reciprocable carriage, a plurality of rotary spindles mounted upon said carriage, a transmission unit having a constant-speed input shaft, a power source coupled with said shaft, a continually rotating constant-speed output shaft geared to said input shaft, carriage draw-in scrolls connectible with said constant-speed output shaft, a variable-speed and intermittently rotatable output shaft, speed-change gearing connecting said intermittently rotatable output shaft with said input shaft, spindle-operating means connected directly with said intermittently rotatable output shaft, carriage draw-out scrolls connectible with said intermittently rotatable output shaft, and means including a constantly rotatable unidirectional cam shaft powered directly from said constant-speed output shaft for starting and stopping and altering the speed of rotation of said intermittently rotatable shaft through said speed-change gears and for connecting and disconnecting said scrolls to and from their respective associated output shafts in a predetermined cycle.

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PHILIP O. SODERLUND.

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