

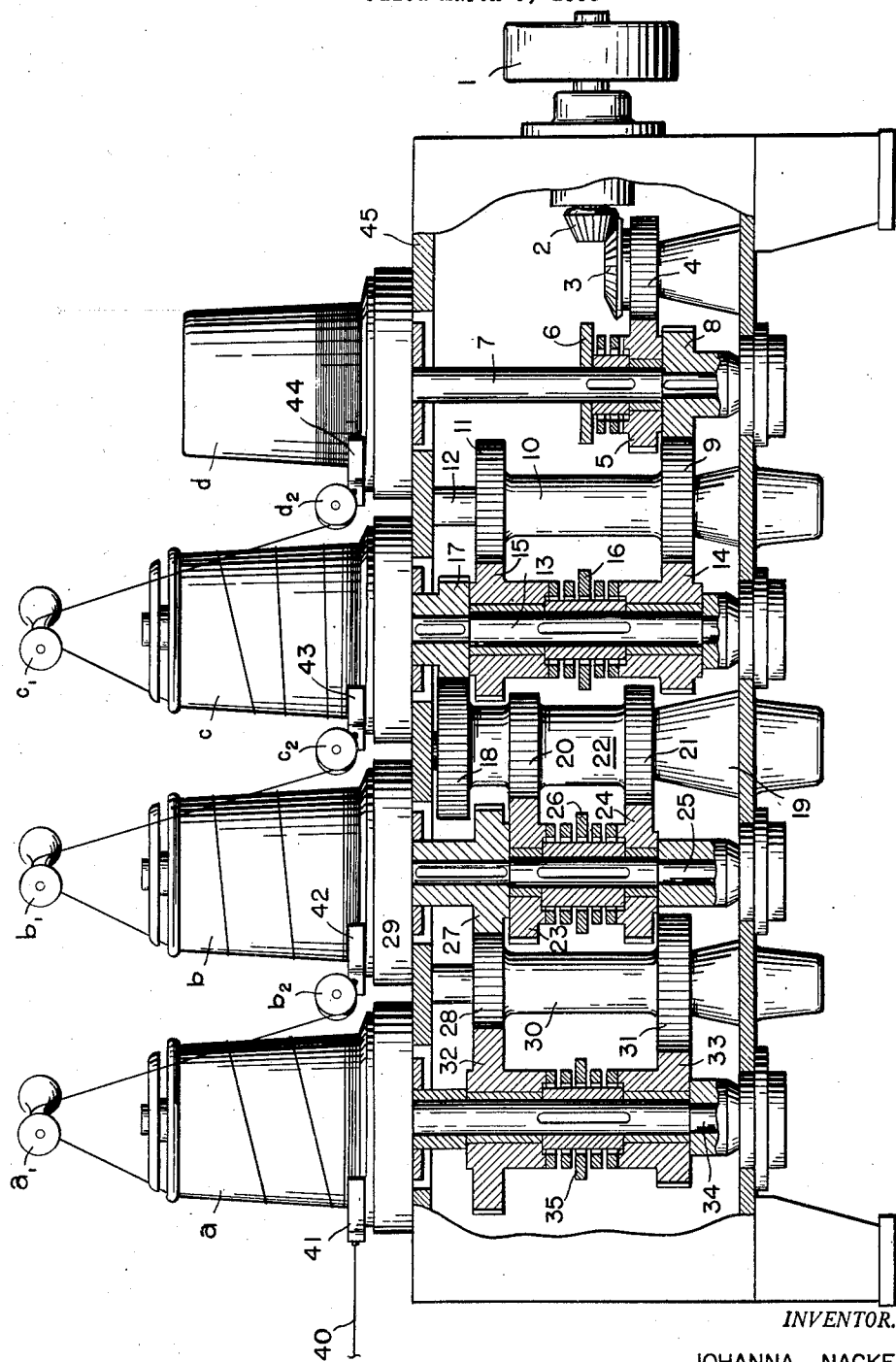
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MULTIPLE-WIRE DRAWING MACHINE TRANSMISSION

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MULTIPLE-WIRE DRAWING MACHINE TRANSMISSION

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4 Claims. (Cl. 74-665)

The invention relates to wire-drawing machines, and more particularly to continuous multiple wire-drawing machines of the slipless type.

Multiple wire-drawing machines of this kind generally comprise several rotary drawing blocks or drums arranged in series and followed by a rotary finishing drum or block, usually in vertical disposition. The wire to be drawn is tangentially fed to the first block near the base thereof, withdrawn in substantially axial direction from the top of this block and guided by sheaves to the base of the next succeeding block through a drawing die or box and so forth. The relative rotational speed of the blocks is correlated to the elongations experienced by the wire during its passages through the dies. If for instance the average elongation of the wire is 27% in each die, each block should revolve 27% slower than the next succeeding one to obtain constant accumulations but in actual practice it is not possible accurately and permanently to maintain a constant elongation from block to block. Accordingly, it is customary to provide a safety factor of about 5%, that is, to rotate each block $27\% - 5\% = 22\%$ slower than the next succeeding one. As a result, each block takes up about 5% more wire from the next preceding block than is withdrawn by the next succeeding one whereby blocks are gradually filled, though not necessarily uniformly.

With slipless multiple wire-drawing machines as heretofore known, it is necessary to stop a block on which the wire accumulation exceeds a certain upper limit and also all the blocks preceding to filled block. The wire is then withdrawn from the stopped blocks until the wire accumulations on the filled block and the other stopped blocks are reduced to a lower limit whereupon the stopped blocks are restarted.

The stopping and restarting of the block is inconvenient. Further, the drawing of wire withdrawn from stopped blocks has an adverse effect upon the wire. As is apparent, wire withdrawn from the top of a stopped block in generally axial direction experiences a twist 360° per winding withdrawn. The resulting tensions and stresses within the wire make the same unsuitable for many purposes, for instance, steel wire so twisted cannot be used for the manufacture of accurately coiled springs.

One of the objects of the present invention is to provide a novel and improved multiple wire-drawing machine of the general type above referred to, which can be continually operated without requiring intermittent stopping of filled blocks.

Another object of the invention is to provide a novel and improved multiple wire-drawing machine of the general type above referred to, which reduces the twist experienced by the wire during withdrawal from a filled block to such an extent that it is practically non-existent and in any event, entirely harmless. As a result, the drawn wire becomes suitable for all purposes.

Still another object of the invention is to provide a novel and improved multiple wire-drawing machine of the gen-

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eral type above referred to, in which wire when run through the machine experiences a slight very slow twist in opposite rotational direction. This twist is so slight that it has an insignificant effect upon the quality of the wire and even this insignificant effect is nullified by twisting of the wire in opposite direction. The twisting of the wire in opposite direction affords the further important advantage of greatly reducing the wear on the die boxes since the opposite rotation of the wire tends to maintain the roundness of the drawing bores. As a result, the necessity of the heretofore used rotation of the dies by means of motor drives is completely eliminated.

A further object of the invention is to provide a novel and improved wire-drawing machine of the general type above referred to, in which all the blocks are continually rotated and if the accumulation of wire on a block exceeds a desired upper limit, the rate of speed of this block and of all the preceding or anterior blocks is reduced relative to the rate speed of the succeeding or posterior block without changing the relative revolutionary speed of the blocks rotating at the reduced speed. As a result, the wire accumulating on the respective block by a certain percentage now decreases by the same percentage. If, for example, the increase of the wire supply on the respective block is 5% and the rate of speed of the block is reduced by 10%, the decrease is also 5%, the rate of speed being $27\% + 5\% = 32\%$ slower than the rate of speed of the succeeding or posterior block. As a result, the wire is twisted through 360° for each twenty windings only whereas upon withdrawal of wire from a stopped block the wire is twisted through 360° for each winding, that is, twenty times as much. As mentioned before, the slight twist in a machine according to the invention is entirely harmless in itself and is in addition, completely nullified since some of the blocks will always be rotated with a rate of speed accumulating wire when the other blocks are rotated with a rate of speed reducing the wire supply so that wire twisted in one direction is subsequently twisted through the same angle in opposite direction.

A still further object of the invention is to provide a novel and improved wire-drawing machine of the general type above referred to, in which the rate of speed of each block on which the supply of wire reaches an upper or a lower limit, can be reduced and increased respectively independently of the position of the block within the machine whereby the rate of speed of all the posterior blocks is equally changed without altering the relative speed of said blocks whereas the rate of speed of the anterior blocks remains unchanged both absolutely and relatively.

Other and further objects and advantages of the invention will be pointed out hereinafter and set forth in the appended claims forming part of the application.

In the accompanying drawing the single figure shows diagrammatically an elevational view, partly in section, of a multiple wire-drawing machine according to the invention by way of illustration and not by way of limitation.

The exemplified machine is a continuous four draw wire-drawing machine of the non-slipping type, shown in its simplest form. It comprises three slightly tapered drawing blocks *a*, *b* and *c* and a finishing block *d*, in vertical arrangement.

Wire 40 to be drawn is fed to the machine, or more specifically to the base of the first block *a* through a die box 41 of conventional design. The wire is withdrawn from the top of block *a* in generally axial direction and guided over guide rolls or sheaves *a*₁, *b*₂ through a die box 42 to the base of block *b*. It is withdrawn from the top of this block and guided over guide rolls or sheaves *b*₁ and *c*₂ through a die box 43 to the base of block *c*. Finally, the wire is guided from the top of box *c* by guide

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rolls or sheaves c_1 and d_2 through a die box 44 to the base of finishing drum d . All the blocks are mounted on a bench 45.

The power drive is preferably connected to the right end of the machine, that is, the end adjacent to block d since at this end the required rotational speed is the highest one. The power drive is shown as a belt pulley 1, but of course a motor may be coupled directly to the machine. The shaft of pulley 1 seats a bevel gear 2 which drives through a bevel gear 3 a spur gear 4. Gear 4 is in mesh with a spur gear 5 which is loosely mounted on a shaft 7 for the end block d . Shaft 7 has fast thereon a spur gear 8. Coupling 6 also mounted on shaft 7 permits to couple gear 5 with shaft 7 for transmission of rotation from pulley 1 to shaft 7. Coupling 6 may be of any suitable design, that is, it may be a mechanical, electromagnetic or hydraulic coupling. The engagement and disengagement of the coupling should be visualized as being effected by any suitable and conventional actuating means well known for the purpose. To simplify illustration, the coupling is shown as a so-called dog teeth coupling having one coupling member keyed to shaft 7 and the other integral with gear 5. As is apparent, coupling 6 is the main coupling of the machine, the engagement and disengagement of which respectively starts or stops the entire machine.

Shaft 7 and with it block d are operatively connected to block c through a variable speed transmission means. This transmission means is shown as comprising an intermediate shaft 12 on which is rotatably seated a bush or sleeve 10. This sleeve mounts two fast gears 9 and 11 of different diameter. Gear 9 is in mesh with a gear 14 and gear 11 is in mesh with a gear 15. Both gears 14 and 15 are rotatable on a shaft 13. This shaft mounts block c and also a gear 17 fixedly seated on the shaft.

A double coupling 16 is mounted on the shaft between gears 14 and 15. As described in connection with coupling 6, the double coupling may be of any suitable design. It is again shown as a dog teeth coupling, one coupling member of which is keyed to shaft 13. The second coupling member is integral with or fixedly secured to gear 14 and the third coupling member to gear 15. As a result, either gear 14 or gear 15 may be coupled to shaft 13 by corresponding actuation of the coupling so that shaft 13 and with it block c is rotated with a rate of speed corresponding to gear 9 or gear 11.

Shaft 13 and with it block c are operatively connected with block b through a variable speed transmission means similar to the one just described. Accordingly, gear 17 is in mesh with a gear 18 fast on a bush or sleeve 22 rotatable on a second intermediate shaft 19. This sleeve also seats two fast gears 20 and 21 of different diameter. Gears 20 and 21 are in mesh with gears 23 and 24 rotatable on a shaft 25. This shaft mounts block b and a gear 27 keyed to the shaft. The shaft further mounts a double coupling 26 similar to coupling 16 previously described for selectively coupling gears 23 and 24 with shaft 25.

Finally, shaft 25 and with it block b is coupled with block a through a variable speed transmission means. This transmission means comprises two gears 28 and 31 which are fast on a bush or sleeve 30 rotatably mounted on an intermediate shaft 29. Gears 28 and 31 are of different diameter. Gear 28 is in mesh with gear 27 and a gear 32, and gear 31 is in mesh with a gear 33. Both gears 32 and 33 are rotatable on a shaft 34. This shaft mounts block a and a double coupling 35 similar to double couplings 16 and 26 previously described. Accordingly, actuation of coupling 35 permits to couple either gear 32 or gear 33 with shaft 34 for transmission of rotation.

As is apparent, actuation of coupling 6 and couplings 16, 26 and 35 either upwards or downwards will transmit rotation of pulley 1 to all the blocks. The ratio of transmission of the transmission means is so correlated that when gears 14, 24 and 33 are coupled with the respec-

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tive shafts each of the blocks rotates with a speed which is faster than the speed of the next preceding or anterior block. This excess of speed is selected to accommodate the elongation experienced by the wire in the respective die and to accumulate on each block a certain percentage of the wire passing through the machine over and above the length of wire withdrawn by the next succeeding or posterior block. Let it be assumed that as previously mentioned the wire is elongated in each die box by 27% and that an accumulation of 5% of the run of wire is desired, the speed of each block will be 22% faster than the speed of the next preceding or anterior block.

The gear ratio of the transmission means when gears 15, 23 and 32 are coupled to the respective shafts, is such that the rate of speed of the blocks is lowered to a speed at which each block takes up less wire from the next preceding or anterior block than is withdrawn from it by the next succeeding or posterior block, or more specifically the rate of speed of the blocks is lowered 10% whereby the supply of wire is reduced by 5% of the run of wire on each block rotating at reduced speed.

Let it now be assumed that the accumulation of wire on block b has reached its upper limit and that it hence becomes necessary to reduce the supply of wire on this block. To accomplish this, the operator actuates coupling 26 so that gear 24 is disengaged from shaft 25 and gear 23 is engaged with shaft 25. As a result, the rate of speed of block b is reduced to the rate of speed for lowering the supply of wire on block b . The absolute rate of speed of the next preceding or anterior block a is similarly reduced but the relative speed of blocks a and b remains unchanged. The rate of speed of blocks c and d is not affected at all by the actuation of coupling 26 so that blocks c and d continue to rotate at the same absolute and relative speed. When the supply of wire on block b has reached or approaches its lower limit, the operator restores the initial rate of speed of blocks a and b by again operating coupling 26 so that gear 23 is disengaged from shaft 25 and gear 24 is engaged with the shaft.

As is apparent, the supply of wire on each of the blocks a , b and c can be controlled in the same manner by operating the respective coupling without the need of stopping any of the blocks. It is further apparent that some of the blocks will always operate at the speed for accumulation of wire when and while other blocks rotate at the speed for reduction of wire so that the slight slow twist experienced by wire withdrawn from a block operating at reduced speed is counteracted by the slow twist experienced by wire withdrawn from a block or blocks rotated at the speed for accumulation of wire.

The actuation of the couplings can be effected manually by the operator supervising the machine as previously described, but it is, of course, also possible to provide detecting means which feel the supply of wire on each block and automatically actuate the respective coupling when the supply of wire reaches its upper or lower limit on the corresponding block. Detecting and feeling means of this type are well known in the art and a detailed description thereof does not appear to be essential for the understanding of the invention.

As is evident, any number of drawing blocks may be provided and controlled as described. It is further evident that instead of variable speed transmission means having two speeds, transmission means having more than two speeds may be provided in the event the specific properties of the wire to be drawn require more than two speeds.

While the invention has been described in detail with respect to a certain now preferred example and embodiment of the invention it will be understood by those skilled in the art after understanding the invention, that various changes and modifications may be made without departing from the spirit and scope of the invention, and it is

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intended, therefore, to cover all such changes and modifications in the appended claims.

What is claimed as new and desired to be secured by Letters Patent, is:

1. A transmission for a continuous wire drawing machine in which the wire to be drawn is guided over a series of rotary drawing blocks, each attenuating the wire by a predetermined percentage, said transmission comprising a plurality of parallel rotary drive shafts, one for each drawing block, a plurality of intermediate shafts, each one of said shafts being disposed between each two drive shafts parallel thereto, two pairs of rotation transmitting means of different ratio of transmission coupling each intermediate shaft with the respective preceding drive shaft as seen in the direction of travel of the wire over successive drawing blocks, each of the pairs formed by an intermediate shaft and the respective preceding drive shaft including a driven member loose on the respective drive shaft and a driving member, a sleeve loose on each intermediate shaft fixedly seating the respective driving members for joint rotation, coupling means on each drive shaft for drivingly coupling a selected one of the driven members thereon to the drive shaft, a driving coupling between the drive shaft for the final drawing block in said series and one of the driving members on the sleeve of the intermediate shaft next preceding, a driving coupling between the drive shaft next preceding the last mentioned intermediate shaft and the sleeve of the intermediate shaft preceding said last mentioned drive shaft, and coupling means for drivingly connecting the drive shaft for said final drawing block to a drive means for the machine whereby upon drivingly coupling one of the driven members on each of the drive shafts with the corresponding driving member on the respective intermediate shaft, all the drive shafts are

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drivingly coupled to each other for rotation upon driving of the drive shaft for said final drawing block.

2. A transmission according to claim 1, wherein the ratios of transmission among said shafts are correlated so that upon drivingly coupling the member of each pair having said one ratio of transmission, each drive shaft rotates at a rate of speed higher than the next preceding shaft and upon drivingly coupling the members of each pair having said other ratio of transmission, each drive shaft rotates at a rate of speed lower than the next preceding drive shaft.

3. A transmission according to claim 2, wherein each of said coupling members for coupling a selected driven member on a drive shaft to the corresponding driving member on the respective intermediate shaft is independently operable.

4. A transmission according to claim 1, wherein the driving members and the driven members on each sleeve and each drive shaft respectively are gears in mesh, the gears on the drive shafts being loose thereon, and wherein said coupling means on the drive shafts are operable for selectively keying one of the gears on the drive shaft thereto for joint rotation on the drive shaft.

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