Sept. 8, 1936. L. L. WEAVER 2,053,645

STRAND HANDLING APPARATUS

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FIG. 1.

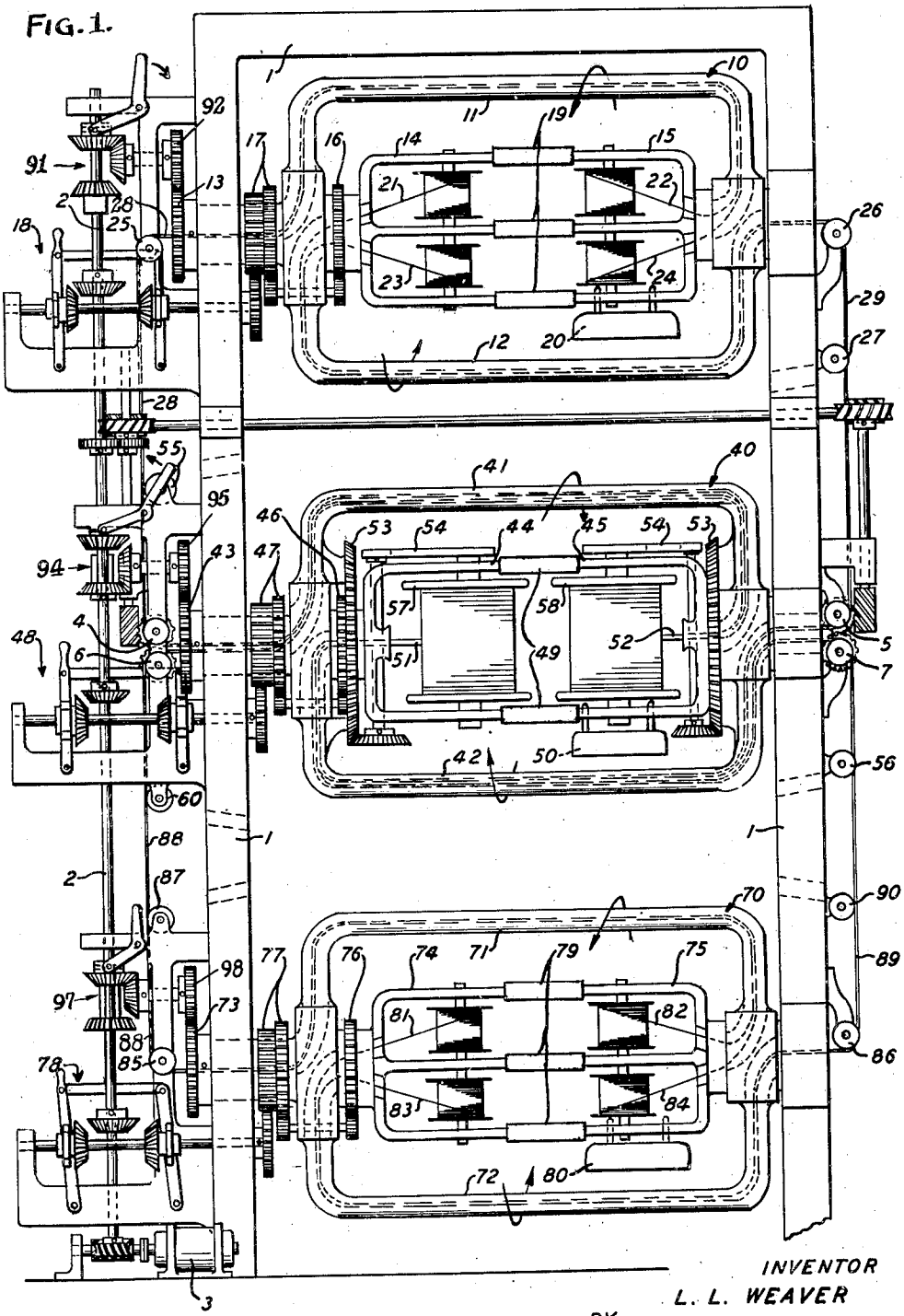

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FIG. 3.

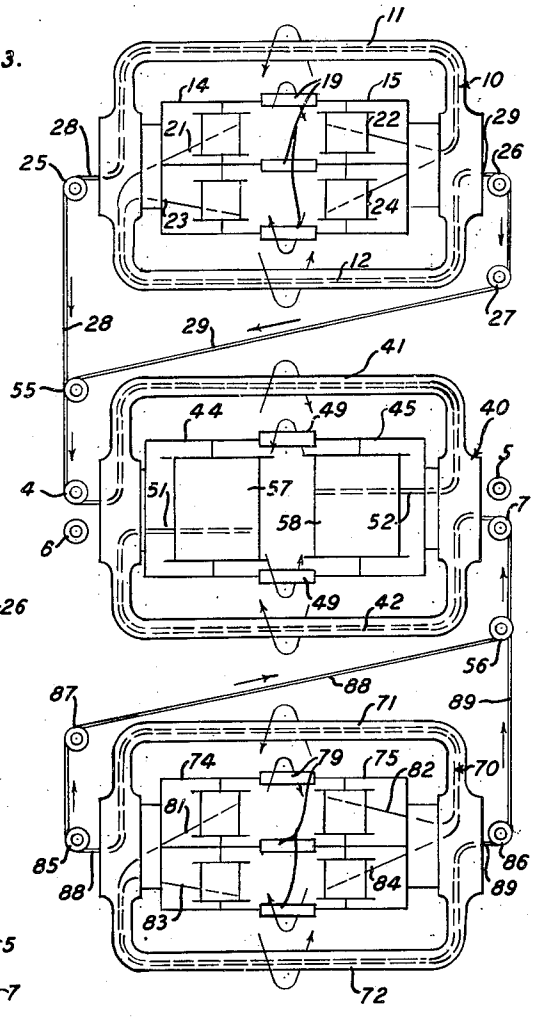

FIG. 2.

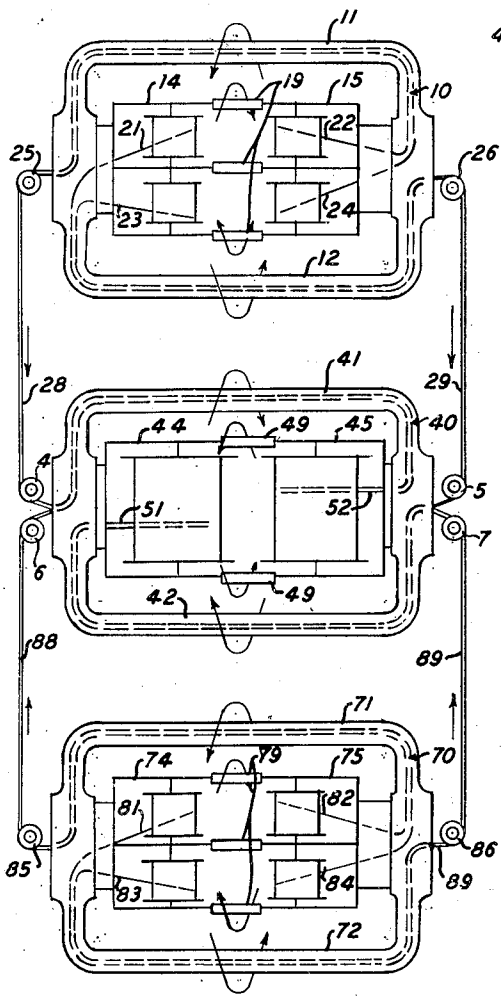

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FIG. 5.

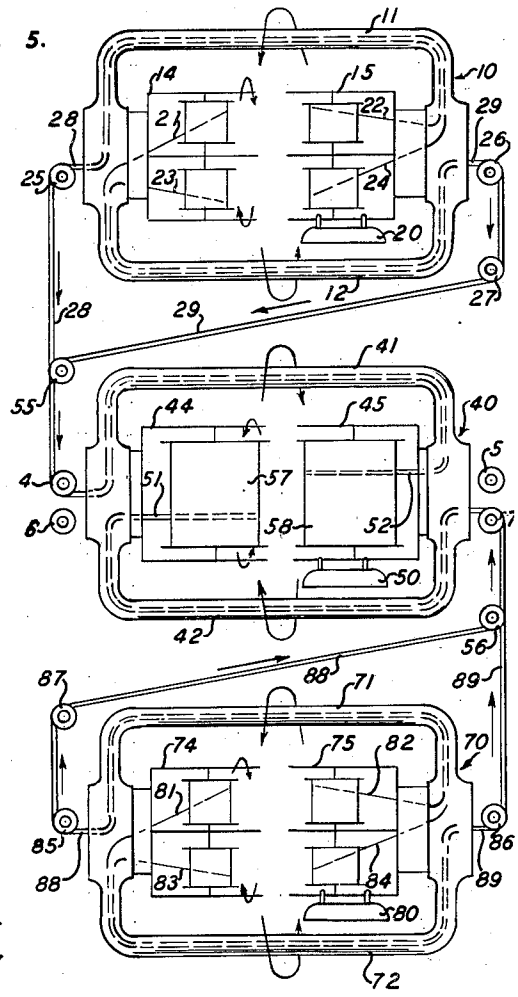

FIG. 4.

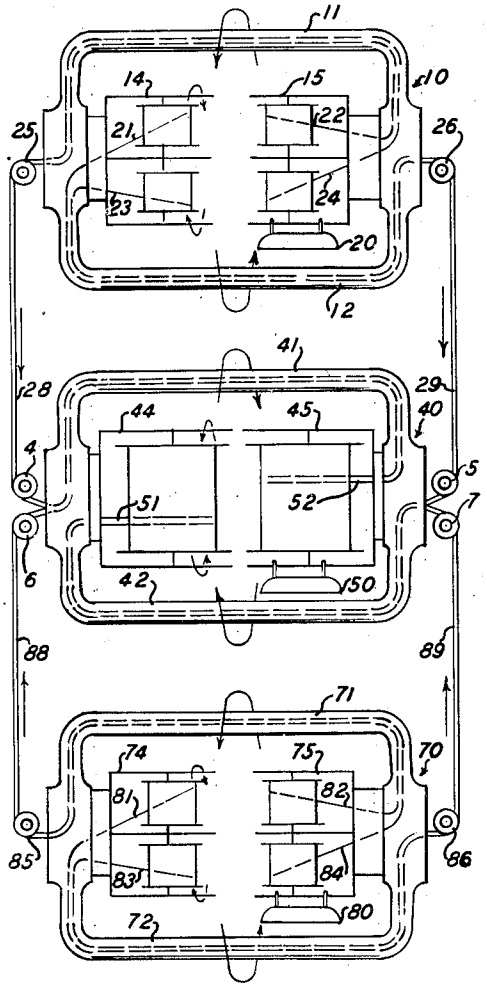

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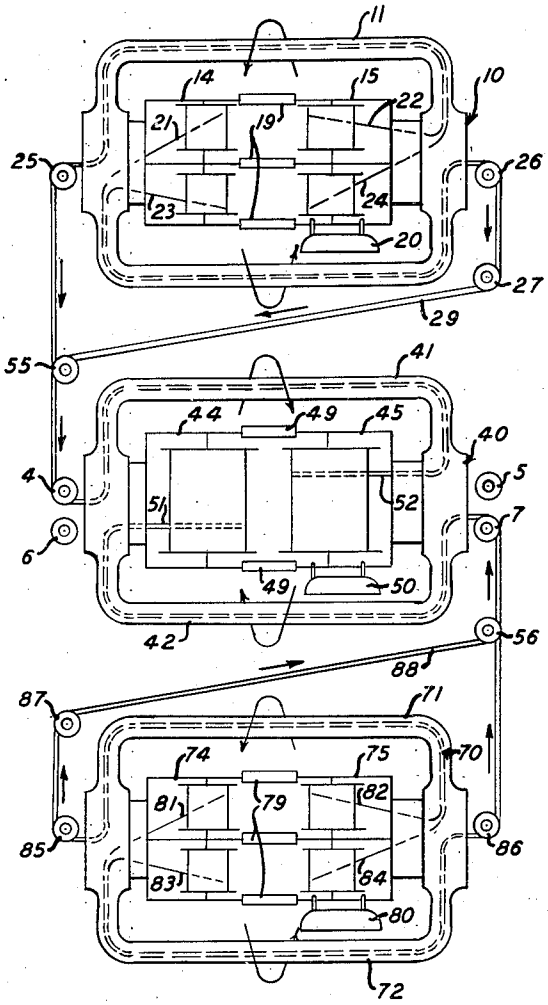
FIG. 6.



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UNITED STATES PATENT OFFICE

2,053,645

STRAND HANDLING APPARATUS

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10 Claims. (Cl. 117—47)

This invention relates to strand handling apparatus and more particularly to apparatus for twisting strands together in pairs and then twisting together two or more such intertwisted pairs.

In the communications field and particularly in the telephone art four strand compound conductor assemblies comprising two intertwisted individually intertwisted pairs of conductors are known as "quads". Quads are made for specific purposes and uses having various combinations of pitch and sense in the three twists involved in a quad.

One object of the present invention is to produce an apparatus capable of producing two quads simultaneously each having a predetermined combination of the three twists, the apparatus being adjustable to produce two symmetrically like or unlike quads at will each having any desired combination as to pitch and sense of the three twists involved.

One embodiment of the invention contemplates a machine having three duplex driven flyers therein, two pairs of rotatable strand supply reels being mounted within each of two of the flyers to be revoluble or stationary as desired, and two driven take-up reels being similarly mounted within the third flyer, and the apparatus having driving means for the several rotatable and revoluble parts adjustable as to speed and direction of motion. The apparatus is thus adjustable to produce four strand "quads" in which any possible combination of the pitches and directions of the three twists involved may appear, as well as three pair and four pair cables. The third flyer in addition to twisting the pairs together to form quads, either increases or decreases the twists of the individual pairs of the completed quad depending upon relative speed and direction of rotation.

Other objects and features of the invention will appear from the following detailed description of one embodiment thereof taken in connection with the accompanying drawings in which Figure 1 is a semi-diagrammatic broken side view of a quad twisting machine constructed in accordance with the invention;

Fig. 2 is a diagrammatic view of the flyers of Fig. 1 showing a second mode of operation;

Fig. 3 is a similar view showing a third mode;

Fig. 4 is a similar view showing a fourth mode;

Fig. 5 is a similar view showing a fifth mode, and

Fig. 6 is a similar view showing a sixth mode.

As herein disclosed the invention is embodied in a machine for intertwisting individually intertwisted pairs of strands, comprising a vertical supporting frame 1 having struts or braces not shown, in which are rotatably mounted three duplex flyers 10, 40 and 70 each having two symmetrical operative arms 11 and 12, 41 and 42, and 71 and 72 respectively. These flyers are suitably journalled in the frame and are provided with driving gears 13, 43 and 73 driven by suitable gearing as shown from a main drive shaft 2 driven by a motor 3. This gearing in each case includes reverse mechanisms generally indicated at 91, 94 and 97 respectively. The gear pairs 13, 92; 43, 95 and 73, 98 are to be thought of as interchangeable for corresponding pairs of different ratios.

Two symmetrical reel support frames 14 and 15, 44 and 45, and 74 and 75 are independently rotatably mounted within each of the flyers and the left hand frames 14, 44 and 74 are provided with gears 16, 46 and 76 driven by planetary gears carried by the flyers from gears 17, 47 and 77 which in turn are driven by suitable gearing as shown from the shaft 2 via reverse clutch mechanisms 18, 48 and 78. The right hand reel support frames 15, 45 and 75 are not directly driven but may be coupled by means of couplings 19, 49 and 79 to the left hand frames to be driven thereby in unison therewith, or if not coupled and driven may be held substantially stationary by means of the removable weights 20, 50 and 80.

Reel support frames 14 and 15, and 74 and 75 are adapted to receive and hold removably interchangeable strand supply reels to supply the strands 21, 23, 22, 24 and 81, 83, 82, 84 which are to be formed into the twisted pairs 29, 28, 89 and 88 and then into the two independent quads 51 and 52 which are taken up on two take-up reels 57 and 58 interchangeably and rotatably mounted in the reel support frames 44 and 45 respectively. These take-up reels are driven as shown from the gears 53, 53 by mechanism including slippable belts 54, 54, to allow for the increasing diameters of the material thereon.

Capstans 4, 6, 5, and 7 are mounted on the frame 1 opposite the inlet openings of the flyer arms 41 and 42 and are driven from the shaft 2 by suitable gearing as shown.

Guide sheaves 25 and 26, and 85 and 86 are mounted on the frame 1 opposite the respective outlets of the flyer arms 11 and 12, and 71 and 72 respectively, and other guide sheaves 27 and 87 are mounted on the frame 1 respectively below the sheave 26 and above the sheave 85, while other guide sheaves 55 and 56 are mounted

on the frame 1 respectively above the capstan 4 and below the capstan 7 and still other guide sheaves 60 and 90 are located below the capstan 7 and above the sheave 86 respectively.

In the above description the details of the various gears, pulleys and other elements of the several drive mechanisms are not described as such mechanisms are familiar, their construction is not relevant to the present invention, and a detailed description with reference numerals would be confusing to the reader.

In one mode of operation weights 20, 50 and 80 and also couplings 19, 49 and 79 are all put in place and devices 18, 48 and 78 are all set at neutral so that frames 14, 15 and 44, 45 and 74, 75 are locked together in pairs, disconnected from the drive and held stationary by the weights. Strands 21 and 23 are threaded through the flyer arm 12, over the sheave 26 and around the capstan 5 to the flyer arm 42. Strands 22 and 24 are threaded through the flyer arm 11, over the sheave 25 and around the capstan 4 to the flyer arm 41. Strands 81 and 83 pass through the flyer arm 72 over the sheave 86 and around the capstan 7 to the flyer arm 42 where they join strands 21 and 23 and the four strands together pass through the flyer arm 42 to form quad 51 on the left hand take-up reel 57. Strands 82 and 84 pass through flyer arm 71, over sheave 85 and around capstan 6 where they join strands 22 and 24 and all four together pass through flyer arm 41 to form quad 52 on the right hand take-up reel 58.

Now assume the machine to be in motion and assume the various drives to be such that the three duplex flyers rotate at the same speed, the two outer ones in one direction, say counterclockwise as seen from the right side while the middle flyer turns in the opposite direction. Assume also that the capstans 4, 6, 5 and 7 are all driven at the same speed as each other, and that the take-up reels 57 and 58 are also driven substantially in synchronism with each other. Then strands 21 and 23 are twisted together with a left hand twist in passing through the flyer arm 12 and emerge therefrom as a twisted pair 29 over the sheave 26 with two turns of twist for each revolution of the flyer 10. The strands 81 and 83 likewise come out of the flyer 70 and over the sheave 86 as a twisted pair 89 with a left hand twist, and since the flyers 10 and 70 rotate at the same speed and also the capstans 5 and 7 draw the strands along at the same longitudinal speed the two pairs 29 and 89 are alike in twist and pitch. The flyer arm 42 is rotating in the other direction from the outer flyers, the two pairs 29 and 89 therefore emerge from the flyer arm 42 to go to the take-up reel 57 twisted together right handedly and with the same pitch of twist in the intertwisting as the pitch of each pair going into the flyer 40.

It will be noted that the resultant twist of the two wires 21 and 23 about each other in the completed quad 51 is the algebraic sum of the twists produced by the flyers 12 and 42. Since these two flyers are rotating in the opposite sense the twist produced by flyer 12 is exactly neutralized by the twist produced by flyer 42, so that the wires 21 and 23 will have a zero twist about each other in the completed quad, while the right hand twist of pair 29 about pair 89 in the quad will be the result of the action of flyer 42 only. A similar result is obtained from the action of flyers 42 and 72 with respect to wires 81 and 83.

The strands 22 and 24, and 82 and 84 are subjected to identical treatment except for the fact that they pass longitudinally in opposite directions although at the same longitudinal speed through the respective flyers and therefore the several twists imposed are of opposite sense while of the same pitch as in the case of the first four strands considered above. Hence the pairs 28 and 88 will be given a left hand twist about each other by the action of flyer arm 41 only while the wires of each of these pairs will have zero twist about one another in the completed quad 52.

In a modification of the above mode of operation, diagrammatically shown in Fig. 2, the weights 20, 50 and 80 are removed, and the devices 18, 48, and 78 are set to drive the frames 14, 44 and 74 as also the frames 15, 45 and 75 coupled thereto all at equal speeds to each other in the opposite directions from the respective flyers within which they are located. The only change this effects is to increase the twists imposed, and the capstans and take-up drives can then be driven correspondingly faster to produce the quads or fours having the same twists and lay as before, but with increased speed of production.

In another mode of operation, diagrammatically shown in Fig. 2, the several drives of the flyers will be set to drive the flyers 10 and 70 in the same sense but with differing speeds and to drive the flyer 40 at an intermediate speed and in the opposite direction, while the several frames 14, 15 and 74, 75 and 44, 45 are driven in the opposite directions to their respective encircling flyers and at correlated speeds. The twist of the wires 21 and 23 about each other in the completed quad will be the algebraic sum of the twists produced by the rotation of the frame 14, the flyer arm 12 and the flyer arm 42, the actions of frame 14 and flyer arm 12 tending to produce twists in one direction and the action of flyer arm 42 tending to produce twists in the opposite direction. The relative speed may be such that the action of flyer arm 42 will more than neutralize the combined action of frame 14 and flyer arm 12 resulting in producing a twist in the opposite sense thereto. The twist of wires 81 and 83 about each other in the completed quad 51 likewise will be the algebraic sum of the twists resulting from the actions of frame 74 and flyer arm 72 tending to produce twists in one direction and the action of flyer arm 42 tending to neutralize the twist so produced. Since flyer arm 42 is operating at a slower speed than flyer arm 72 the twist produced by the action of flyer arm 72 and frame 74 will not be entirely neutralized and therefore part of this twist will remain in the wires in the completed quad. The twists of the wires of either pair may be of the same or opposite sense with respect to the wires of the other pair of the quad. As before the twist of the pairs 29 and 89 about each other in the completed quad will result from the action of flyer arm 42 only. In a corresponding manner the pair and quad twist of pairs 28 and 88 in quad 52 will correspond with the pair and quad twist of pairs 29 and 89 and quad 51 but of opposite sense respectively.

In a fourth mode of operation, the frame pairs 14, 15 and 74, 75 and 44, 45 are interconnected as before to be locked together, and may be disconnected from their drives and held stationary by the weights, or the latter may be removed and the frames driven in the opposite direction to their respective associated flyers as diagrammatically shown in Fig. 3. The pair 88 is now,

however, led over the sheaves 87 and 56 to join the pair 89 on the capstan 7, and the pair 29 is brought over the sheaves 27 and 55 to join the pair 28 on the capstan 4. The capstans 5 and 6 are then idle. If now the flyers 10 and 70 be driven at the same speed and in the same direction (counterclockwise from the right) and flyer 40 in the opposite direction and at the same speed, the quad 52 will comprise a right hand twist pair 28 and a left hand twist pair 29 of identical pitch, twisted together left handedly with the same pitch, while quad 51 will be composed of a right hand twist pair 88 and a left hand twist pair 89 of identical pitch, twisted together right handedly with the same pitch. If the relative speeds of the flyers be different, the pitches of the quad twists will be of equal value and opposite sense to each other, and will differ from the pitches of their component pairs; while the pitches of the two pairs entering into each quad will still be of identical value and opposite sense to each other, and the identical pitches of the pairs in one quad will differ from those in the other. However, as before the pair twists of the completed quads will be the algebraic sum of the twists resulting from the actions of frames 14, 15, 74, 75, 44 and 45 and flyers 10, 70 and 40.

In a fifth mode of operation, diagrammatically illustrated in Fig. 4, the weights 20, 50 and 80 are retained in place on the frames 15, 45 and 75, while the couplings 19, 49 and 79 are removed and the clutches 18, 48 and 78 are set to drive the frames 14, 44 and 74 in the opposite direction to the rotation of their respective associated flyers. The pairs 28 and 29 then are opposite in sense of twist and differ in pitch. The pairs 88 and 89 are opposite in sense and differ in pitch. Also, if flyers 10 and 70 rotate in a common direction at the same speed, pairs 28 and 88 are identical in pitch and in sense as also are pairs 29 and 89; while if flyers 10 and 70 have different speeds, then no two of the four pairs 28, 29, 88 and 89 will agree in both pitch and twist. Hence the quads 51 and 52, according to which two pairs compose each, may each have two pairs of identical sense and different pitch or of opposite sense and different pitch, and in either case the intertwist of the two pairs in 51 will differ from that of 52.

In a sixth method of operation, illustrated in Fig. 6, the flyers 10 and 70 may be rotated in different directions at different speeds while flyer 40 may be rotated at a third speed and the weights 20, 50 and 80 may be placed in position to maintain the frames 15, 45 and 75 stationary and couplings 19, 49 and 79 placed in position to hold frames 14, 44 and 74 stationary also with the driving mechanisms 18, 48 and 78 set in neutral. Alternatively, as indicated in Fig. 5 the couplings may be disconnected and the frames driven at independent speeds and sense. Pairs 28 and 29 may be led into the same or different take-up flyer arms as desired and pairs 88 and 89 may be treated correspondingly. In any case the resultant pair twist of any pair in its completed quad will be the algebraic sum of the actions of its associated frames and flyers.

It will be clear from the above that a machine constructed as described can be arranged and adjusted to produce a quad having substantially any practicable desired combination of pair twists and quad twist and furthermore may be arranged to produce two such quads simultaneously which may be symmetrically alike, or totally dissimilar.

The machine may also be arranged to produce cables of six strands in three pretwisted pairs or of eight strands in four pretwisted pairs. Thus if frame 74 be left empty, and pairs 28, 29 and 88 be all brought together over the capstans 4 and 6 and through the flyer arm 41, then cable 52 will be a six strand, three pair compound; while if pair 89 be also brought over sheaves 90 and 60, then cable 52 will be composed of eight strands in four pretwisted pairs.

The embodiments of the invention herein disclosed are illustrative only and may be widely modified and departed from in many ways without departing from the spirit and scope of the invention as pointed out in and limited solely by the appended claims.

What is claimed is:

1. An apparatus for handling strands comprising a first duplex rotatable flyer, a first means to support a first and a second pair of strand supplies within the first flyer to supply a pair of strands to each arm of the first flyer to be twisted thereby to form a first and a second twisted pair, a second duplex rotatable flyer, a second means to support a third and a fourth pair of strand supplies within the second flyer to supply a pair of strands to each arm of the second flyer to be twisted thereby to form a third and a fourth twisted pair, a third duplex rotatable flyer, two take-up means within the third flyer to receive strands respectively from each of the two arms of the flyer, and means to guide each of the four twisted pairs from the flyer arm in which the pair is formed to the third flyer.

2. An apparatus for handling strands comprising a first duplex rotatable flyer, a first means to rotatably support a first and a second pair of strand supplies within the first flyer to supply a pair of strands to each arm of the first flyer to be twisted thereby to form a first and a second twisted pair, a second duplex rotatable flyer, a second means to rotatably support a third and a fourth pair of strand supplies within the second flyer to supply a pair of strands to each arm of the second flyer to be twisted thereby to form a third and a fourth twisted pair, a third duplex rotatable flyer, two revoluble and rotatable take-up means within the third flyer to receive strands respectively from each of the two arms of the flyer, and means to guide each of the four twisted pairs from the flyer arm in which the pair is formed to the third flyer.

3. An apparatus for handling strands comprising a first duplex rotatable flyer, a first means to support a first and a second pair of strand supplies within the first flyer to supply a pair of strands to each arm of the first flyer to be twisted thereby to form a first and a second twisted pair, a second duplex rotatable flyer, a second means to support a third and a fourth pair of strand supplies within the second flyer to supply a pair of strands to each arm of the second flyer to be twisted thereby to form a third and a fourth twisted pair, a third duplex rotatable flyer, two take-up means within the third flyer to receive strands respectively from each of the two arms of the flyer, means to guide each of the four twisted pairs from the flyer arm in which the pair is formed to the third flyer, and reversible means to drive each of the three flyers.

4. An apparatus for handling strands comprising a first duplex rotatable flyer, a first means to support a first and a second pair of strand supplies within the first flyer to supply a pair

of strands to each arm of the first flyer, to be twisted thereby to form a first and a second twisted pair, a second duplex rotatable flyer, a second means to support a third and a fourth pair of strand supplies within the second flyer to supply a pair of strands to each arm of the second flyer to be twisted thereby to form a third and a fourth twisted pair, a third duplex rotatable flyer, two take-up means within the third flyer to receive strands respectively from each of the two arms of the flyer, means to guide each of the four twisted pairs from the flyer arm in which the pair is formed to the third flyer, and means individually adjustable as to speed and reversible as to direction to drive each flyer.

5. An apparatus for handling strands comprising a first duplex rotatable flyer, a first means to rotatably support a first and a second pair of strand supplies within the first flyer to supply a pair of strands to each arm of the first flyer to be twisted thereby to form a first and a second twisted pair, a second duplex rotatable flyer, a second means to rotatably support a third and a fourth pair of strand supplies within the second flyer to supply a pair of strands to each arm of the second flyer to be twisted thereby to form a third and a fourth twisted pair, a third duplex rotatable flyer, two revoluble and rotatable take-up means within the third flyer to receive strands respectively from each of the two arms of the flyer, means to guide each of the four twisted pairs from the flyer arm in which the pair is formed to the third flyer, means to drive the strand supplies in rotation, reversible means to drive each of the three flyers, and means to revolve and to rotate the take-up means.

6. An apparatus for handling strands comprising a first duplex rotatable flyer, a first means to independently and rotatably support a first and a second pair of strand supplies within the first flyer to supply a pair of strands to each arm of the first flyer to be twisted thereby to form a first and a second twisted pair, a second duplex rotatable flyer, a second means to independently and rotatably support a third and a fourth pair of strand supplies within the second flyer to supply a pair of strands to each arm of the second flyer to be twisted thereby to form a third and a fourth twisted pair, a third duplex rotatable flyer, two independently revoluble and rotatable take-up means within the third flyer to receive strands respectively from each of the two arms of the flyer, means to guide each of the four twisted pairs from the flyer arm in which the pair is formed to the third flyer, means individually adjustable as to speed and reversible as to direction to drive each flyer, and means to drive one of the pairs of strand supplies within the first flyer and one within the second flyer.

7. An apparatus for handling strands comprising a first duplex rotatable flyer, a first means to independently and rotatably support a first and a second pair of strand supplies within the first flyer to supply a pair of strands to each arm of the first flyer to be twisted thereby to form a first and a second twisted pair, a second duplex rotatable flyer, a second means to independently and rotatably support a third and a fourth pair of strand supplies within the second flyer to supply a pair of strands to each arm of the second flyer to be twisted thereby to form a third and a fourth twisted pair, a third duplex rotatable flyer, two independently revoluble and rotatable take-up means within the third flyer to receive strands respectively from each of the two arms of the flyer, means to guide each of the four twisted pairs from the flyer arm in which the pair is formed to the third flyer, means individually adjustable as to speed and reversible as to direction to drive each flyer, means to drive one of the pairs of strand supplies within the first flyer and one within the second flyer, and means to couple the other strand supply within the first flyer and within the second flyer to the respective driven supplies therein to be driven thereby.

8. An apparatus for handling strands comprising a first duplex rotatable flyer, a first means to independently and rotatably support a first and a second pair of strand supplies within the first flyer to supply a pair of strands to each arm of the first flyer to be twisted thereby to form a first and a second twisted pair, a second duplex rotatable flyer, a second means to independently and rotatably support a third and a fourth pair of strand supplies within the second flyer to supply a pair of strands to each arm of the second flyer to be twisted thereby to form a third and a fourth twisted pair, a third duplex rotatable flyer, two independently revoluble and rotatable take-up means within the third flyer to receive strands respectively from each of the two arms of the flyer, means to guide each of the four twisted pairs from the flyer arm in which the pair is formed to the third flyer, means individually adjustable as to speed and reversible as to direction to drive each flyer, means to drive one strand supply within the first flyer and one within the second flyer, and means to hold the other strand supplies stationary.

9. In a strand handling apparatus, a duplex flyer, two strand supply supports independently rotatably mounted therein to supply strands respectively to the two arms of the flyer, means to drive one support directly, and means to couple the other support thereto to be driven thereby.

10. In a strand handling apparatus, a duplex flyer, two strand supply supports independently rotatably mounted therein to supply strands respectively to the two arms of the flyer, means to drive one support, and means to hold the other support stationary.

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