

TERMINAL INSERTION APPARATUS

BACKGROUND OF THE INVENTION

5 1. Field of the Invention

The present invention relates to a terminal insertion apparatus which inserts terminals that are attached to electrical wires into terminal insertion holes of a connector housing during the production of a wire harness.

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2. Description of the Related Art

The terminal insertion apparatus described in FIG. 5 (see JP10-112229A), for example, has been known in the past as a terminal insertion apparatus which inserts a terminal attached to an electrical wire into a terminal insertion hole of a connector housing during the production of a wire harness.

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FIG. 5 is a side view of a terminal insertion apparatus according to JP10-112229A. FIG. 6 is a side view showing a terminal insertion head provided in the terminal insertion apparatus shown in FIG. 5.

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The terminal insertion apparatus 50 shown in FIG. 5 comprises a pair of X-axis beams 52 installed on frames 51, a Y-axis beam 53 supported on the respective X-axis beams 52 in a movable manner, a terminal insertion head 54 capable of moving along the Y-axis beam 53, and a connector gripping unit 55 similarly capable of moving along the Y-axis beam 53.

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As is shown in FIG. 5, the terminal insertion head 54 is attached to the rail 57 of the Y-axis beam 53 in a movable manner via a linear motion guide (LM guide) 56.

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As is shown in FIGS. 5 and 6, the terminal insertion head 54 comprises a frame 58 fastened to the linear motion guide 56, a first base plate part 60 attached to the frame 58 via a ball screw unit 59 so as to be freely raised and lowered, and a second base plate part 62 attached to the first base plate part 60 via a vertical cylinder 61 so as to be freely raised and lowered.

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An electrical wire separation unit 63 is installed at the front end of the first base plate part 60. Furthermore, a terminal gripping unit 64 is installed on the second base plate part 62.

The electrical wire separation unit 63 comprises a pair of electrical wire separation claws 65 capable of opening and closing in the left-right direction (depth direction in FIGS. 5 and 6), and a chuck cylinder 66 that causes the electrical wire separation claws 65 to open and close.

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The terminal gripping unit 64 comprises a pair of front-side electrical wire gripping hands 68, a pair of rear-side electrical wire gripping hands 69, a first chuck cylinder 70 that causes the front-side electrical wire gripping hands 68 to open and close in the left-right direction, and a second chuck cylinder 71 that causes the rear-side electrical wire gripping hands 69 to open and close in the left-right direction. Moreover, the terminal gripping unit 64 comprises a first horizontal cylinder 72 that causes the entire terminal gripping unit 64 to

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advance and retract, and a second horizontal cylinder 73 that causes only the rear-side electrical wire gripping hands 69 to advance and retract.

When the terminal C attached to each electrical wire W is to be inserted into a terminal insertion hole of a connector housing 67 by means of the terminal insertion apparatus 50, the ball screw unit 59 first lowers the terminal insertion head 54, and the vertical cylinder 61 lowers the two sets of electrical wire gripping hands 68 and 69. Then, the two sets of electrical wire gripping hands 68 and 69 grip the terminal of an electrical wire W that is set in an electrical wire clip 74.

Next, the ball screw unit 59 raises the entire terminal insertion head 54, and the vertical cylinder 61 raises the two sets of electrical wire gripping hands 68 and 69. Then, the terminal insertion head 54 moves along the Y-axis beam 53 so as to be above the connector housing 67 that is gripped by the connector gripping unit 55.

Furthermore, the ball screw unit 59 again lowers the terminal insertion head 54, thus causing the electrical wire separation claws 65 of the electrical wire separation unit 63 to be inserted between lead electrical wires (not shown in the figures) that are led out from the connector housing 67. Moreover, the chuck cylinder 66 opens the electrical wire separation claws 65, so that a state is created in which the lead electrical wires are separated.

Afterward, the first horizontal cylinder 72 on the upper side causes the two sets of electrical wire gripping hands 68 and 69 to advance integrally with the second base plate part 62. As a result, the terminal C is temporarily inserted into a terminal insertion hole of the connector housing 67.

Then, the front-side electrical wire gripping hands 68 are opened, the second horizontal cylinder 73 is extended, and the electrical wire W is pushed only by the rear-side electrical wire gripping hands 69. As a result, the terminal C is completely inserted into the terminal insertion hole of the connector housing 67.

Because lead electrical wires of terminals C that have already been inserted into terminal insertion holes of the connector housing 67 can be separated using such a terminal insertion apparatus 50, it is possible to reliably perform the insertion of each terminal C into a terminal insertion hole of the connector housing 67.

However, in the terminal insertion apparatus 50 shown in FIGS. 5 and 6, it is necessary to perform the insertion of terminals C attached to electrical wires W into terminal insertion holes of the connector housing 67 for one terminal at a time for each electrical wire W during the production of a wire harness. Accordingly, there is a problem in that it is difficult to increase the wire harness production efficiency.

SUMMARY OF THE INVENTION

Embodiments of the present invention provide a terminal insertion apparatus which makes it possible to perform the insertion of terminals attached to electrical wires into terminal insertion holes of the connector housing for two electrical wires at the same time during wire harness production.

In an aspect of the present invention, there is provided a terminal insertion apparatus which inserts terminals attached to electrical wires that are held by a clamp means into specified terminal insertion holes of a connector housing, wherein

this apparatus comprises an electrical wire gripping unit having two sets of chuck means that respectively grip two of the electrical wires held by the clamp means at a specified arrangement pitch, and

the two chuck means change the arrangement pitch of the electrical wires that are gripped by these two chuck means from the specified arrangement pitch to an arrangement pitch at which the terminals attached to the electrical wires that are gripped by the two chuck means can be inserted into specified terminal insertion holes of the connector housing.

In an embodiment, the electrical wire gripping unit may comprise a pair of outer claws opened and closed by a first air chuck and a pair of inner claws opened and closed by a second air chuck,

one chuck means of the two chuck means is formed from one outer claw of the two outer claws and one inner claw of the two inner claws,

the other chuck means of the two chuck means is formed from the other outer claw of the two outer claws and the other inner claw of the two inner claws, and

the change in the arrangement pitch of the electrical wires that are gripped by the two chuck means is performed by the first air chuck causing the two outer claws to move inward, so that the two outer claws press the two inner claws inward.

The above terminal insertion apparatus may further comprise terminal guides that support the terminals attached to the electrical wires.

In the above terminal insertion apparatus, the arrangement pitch of the electrical wires that are gripped by the two chuck means is changed from a specified arrangement pitch at which the electrical wires are held by the clamp means to an arrangement pitch at which the terminals attached to the electrical wires can be inserted into specified terminal insertion holes of the connector housing. Accordingly, it is possible to insert the terminals attached to electrical wires into terminal insertion holes of a connector housing for two electrical wires at the same time during wire harness production.

Moreover, in the above terminal insertion apparatus, the electrical wire gripping unit comprises a pair of outer claws opened and closed by a first air chuck and a pair of inner claws opened and closed by a second air chuck, one chuck means of the two chuck means is formed from one outer claw of the two outer claws and one inner claw of the two inner claws, the other chuck means of the two chuck means is formed from the other outer claw of the two outer claws and the other inner claw of the two inner claws, and the change in the arrangement pitch of the electrical wires that are gripped by the two chuck means is performed by the first air chuck causing the two outer claws to move inward, so that the two outer claws press the two inner claws inward. Accordingly, the gripping of two electrical wires and the changing of the arrangement pitch of the two electrical wires can be performed using two sets of drive systems.

In addition, in the above terminal insertion apparatus, because terminal guides that support the terminals attached to the electrical wires are provided, it is possible to prevent the occurrence of positional deviation between the terminals and terminal insertion

holes when the terminals attached to the electrical wires are inserted into the terminal insertion holes of the connector housing.

BRIEF DESCRIPTION OF THE DRAWINGS

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FIG. 1 is a perspective view showing the schematic structure of essential parts of the terminal insertion apparatus of an embodiment of the present invention;

FIG. 2 is a front view of the terminal insertion apparatus shown in FIG. 1;

FIG. 3 is a side view of the terminal insertion apparatus shown in FIG. 1;

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FIG. 4 is a perspective view showing the schematic structure of the chuck means provided in the terminal insertion apparatus shown in FIG. 1;

FIG. 5 is a side view of the terminal insertion apparatus of JP10-112229A; and

FIG. 6 is a side view showing the terminal insertion head provided in the terminal insertion apparatus shown in FIG. 5.

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DESCRIPTION OF THE PREFERRED EMBODIMENTS

The terminal insertion apparatus of an embodiment of the present invention will be described below with reference to the figures.

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FIG. 1 is a perspective view showing the schematic structure of essential parts of the terminal insertion apparatus of an embodiment of the present invention. FIG. 2 is a front view of the terminal insertion apparatus shown in FIG. 1. FIG. 3 is a side view of the terminal insertion apparatus shown in FIG. 1. FIG. 4 is a perspective view showing the schematic structure of the chuck means provided in the terminal insertion apparatus shown in FIG. 1. Furthermore, for the convenience of description, the terminal guides or the like are omitted in FIG. 1.

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The terminal insertion apparatus 1 shown in FIG. 1 is used to insert terminals C attached to one end of electrical wires W into terminal insertion holes F of a connector housing H during wire harness production.

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As is shown in FIGS. 1 through 3, the terminal insertion apparatus 1 comprises an electrical wire supporting unit 2 arranged on the surface of a base (not shown in the figures), a connector holding unit 3 similarly arranged on the surface of the base, and a terminal insertion head 4 attached to a side wall B that is vertically installed on the base.

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The electrical wire supporting unit 2 comprises a clamp means 6 for holding electrical wires W, and a terminal carrying means 7 for carrying terminals C that are attached to the electrical wires W.

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The clamp means 6 can hold a plurality of electrical wires W (two electrical wires in the present embodiment) at a specified arrangement pitch α (approximately 8 mm in the present embodiment, for example). Furthermore, in cases where the specified arrangement pitch α of the electrical wires W held by the clamp means 6 is set at 8 mm, this arrangement pitch α is a relatively narrow pitch for clamp means provided in automated apparatuses of this type.

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The connector holding unit 3 comprises a base plate part 9 on which the connector housing H is carried, and a locking means 10 for locking the connector housing H carried on the base plate part 9.

5 The terminal insertion head 4 comprises a first base plate part 13 attached to the side wall B via a vertical air cylinder 12 so as to be freely raised and lowered, a second base plate part 15 attached to the first base plate part 13 via a horizontal air cylinder 14 so as to be freely moved horizontally, and an electrical wire gripping unit 16 attached to the second base plate part 15.

10 The electrical wire gripping unit 16 comprises a pair of outer claws 21a and 21b opened and closed by a first air chuck 18 and a pair of inner claws 22a and 22b opened and closed by a second air chuck 19. The first air chuck 18 and second air chuck 19 are attached to the second base plate part 15.

15 As is shown in FIG. 4, each of the outer claws 21a and 21b is formed substantially in the shape of the letter "L" as seen from the left-right direction (left-right direction in FIGS. 1 and 4). Grip parts 23 that protrude downward in the vertical direction (vertical direction in FIGS. 1 and 4) are respectively provided at the tip end portions of the outer claws 21a and 21b.

20 Each of the inner claws 22a and 22b is formed substantially in the shape of the letter "L" as seen from the left-right direction as shown in FIG. 4. Grip parts 24 that protrude downward in the vertical direction are respectively provided at the tip end portions of the inner claws 22a and 22b.

25 In the electrical wire gripping unit 16, the grip parts 24 of the two inner claws 22a and 22b are arranged between the grip parts 23 of the two outer claws 21a and 21b. In the electrical wire gripping unit 16, furthermore, the two inner claws 22a and 22b and two outer claws 21a and 21b are arranged so that the grip parts 24 of the two inner claws 22a and 22b and the grip parts 23 of the two outer claws 21a and 21b overlap as seen from the left-right direction. Moreover, in the initial state of the electrical wire gripping unit 16, the two inner claws 22a and 22b are arranged with a specified distance in the left-right direction as shown in FIGS. 1 and 4 so as to allow the gripping of the two electrical wires W arranged at the specified arrangement pitch α .

30 Furthermore, the one-side outer claw 21a and one-side inner claw 22a make up a first chuck means 26a. The first chuck means 26a grips one of the electrical wires W with the inner surface of the grip part 23 of the outer claw 21a and the outer surface of the grip part 24 of the inner claw 22a.

35 Moreover, the other-side outer claw 21b and the other-side inner claw 22b make up a second chuck means 26b. The second chuck means 26b grips the other electrical wire W with the inner surface of the grip part 23 of the outer claw 21b and the outer surface of the grip part 24 of the inner claw 22b.

40 With regard to the first chuck means 26a and second chuck means 26b, the first air chuck 18 causes the two outer claws 21a and 21b to move outward, and the second air chuck 19 causes the two inner claws 22a and 22b to move inward, so that the two sets of grip parts 23 and 24 of the respective chuck means 26a and 26b are placed in an open state.

With regard to the first chuck means 26a and second chuck means 26b, furthermore, the first air chuck 18 causes the two outer claws 21a and 21b to move inward, and the second air chuck 19 causes the two inner claws 22a and 22b to move outward, so that the two sets of grip parts 23 and 24 of the respective chuck means 26a and 26b are placed in a closed state.

Thus, the electrical wire gripping unit 16 makes it possible to grip or release the electrical wires W between the two sets of grip parts 23 and 24 of the respective chuck means 26a and 26b by opening or closing the two sets of grip parts 23 and 24 of the respective chuck means 26a and 26b.

In the two chuck means 26a and 26b that are in a state in which the two sets of grip parts 23 and 24 are closed, the first air chuck 18 causes the two outer claws 21a and 21b to move further inward, so that the two outer claws 21a and 21b press the two inner claws 22a and 22b inward, thus reducing the distance between the two inner claws 22a and 22b. As a result, it is possible to move the two sets of grip parts 23 and 24 of the two chuck means 26a and 26b inward in the direction of arrangement of the two chuck means 26a and 26b (left-right direction in FIG. 1). Consequently, the electrical wire gripping unit 16 can change the arrangement pitch of the two electrical wires W gripped by the two sets of grip parts 23 and 24 of the two chuck means 26a and 26b to a smaller pitch.

In the two chuck means 26a and 26b that are in a state in which the two sets of grip parts 23 and 24 are closed, the second air chuck 19 causes the two inner claws 22a and 22b to move further outward, so that the two inner claws 22a and 22b press the two outer claws 21a and 21b outward, thus increasing the distance between the two inner claws 22a and 22b. As a result, it is possible to move the two sets of grip parts 23 and 24 of the two chuck means 26a and 26b outward in the direction of arrangement of the two chuck means 26a and 26b. Consequently, the electrical wire gripping unit 16 can change the arrangement pitch of the two electrical wires W gripped by the two sets of grip parts 23 and 24 of the two chuck means 26a and 26b to a larger pitch.

Thus, the first chuck means 26a and second chuck means 26b can change the arrangement pitch of the two electrical wires W gripped by the two sets of grip parts 23 and 24 of these two chuck means 26a and 26b from the specified arrangement pitch α , at which these electrical wires W have been held by the clamp means 6 to an arrangement pitch β at which the terminals C attached to the electrical wires W that are gripped by the two sets of grip parts 23 and 24 of the two chuck means 26a and 26b can be simultaneously inserted into specified terminal insertion holes F of the connector housing H.

In this case, by causing the inner surface of the inner claw 22a of the first chuck means 26a and the inner surface of the inner claw 22b of the second chuck means 26b to contact each other as shown in FIG. 2, the arrangement pitch of the two electrical wires W gripped by the two sets of grip parts 23 and 24 of these two chuck means 26a and 26b is set at the arrangement pitch β (3 mm in the present embodiment, for example), which allows the simultaneous insertion of the terminals C attached to the electrical wires W that are gripped by the two sets of grip parts 23 and 24 of the two chuck means 26a and 26b into specified terminal insertion holes F of the connector housing H.

Furthermore, in the two chuck means 26a and 26b that are in a state in which the two inner claws 22a and 22b contact each other, the distance between the two inner claws 22a and

22b is returned to the specified distance described above by the first air chuck 18 causing the two outer claws 21a and 21b to move outward.

Moreover, as is shown in FIGS. 2 and 3, the electrical wire gripping unit 16 is provided with a pair of terminal guides 29 that are opened and closed by a terminal guide air cylinder 28. The terminal guide air cylinder 28 is attached to the second base plate part 15.

Recessed parts 30 that can support the terminals C attached to the electrical wires W are respectively formed on the inside of the lower end portions of these terminal guides 29. The recessed parts 30 of the respective terminal guides 29 support the outside of the respective terminals C carried on the terminal carrying means 7.

Next, actions that are taken when the terminals C attached to the electrical wires W are inserted into terminal insertion holes F of the connector housing H by the terminal insertion apparatus 1 will be described.

When the terminals C attached to the electrical wires W are to be inserted into terminal insertion holes F of the connector housing H by means of the terminal insertion apparatus 1, the two electrical wires W to which the terminals C have been crimped beforehand in a previous step are first set in the electrical wire supporting unit 2. In this case, the respective electrical wires W are held by the clamp means 6, and the terminals C attached to the respective electrical wires W are placed on the terminal carrying means 7. Here, the arrangement pitch α of the two electrical wires W held by the clamp means 6 is set at 8 mm.

Furthermore, the connector housing H is set in the connector holding unit 3. In this case, the connector housing H is carried on the base plate part 9, and the connector housing H carried on the base plate part 9 is locked by the locking means 10.

Here, in the electrical wire gripping unit 16 that is in the initial state, the two outer claws 21a and 21b are arranged in a state in which these outer claws are moved outward, and the two inner claws 22a and 22b are arranged in a state in which these inner claws are moved inward, so that the two sets of grip parts 23 and 24 of the respective chuck means 26a and 26b are placed in a mutually open state.

Moreover, in the electrical wire gripping unit 16 that is in the initial state, the two inner claws 22a and 22b assume a state in which these inner claws are arranged with a specified distance in the left-right direction so that these inner claws can grip the two electrical wires W that are arranged at the specified arrangement pitch α .

In addition, in the electrical wire gripping unit 16 that is in the initial state, the two terminal guides 29 are in a mutually open state by being arranged in a state in which these terminal guides are moved outward.

Then, the vertical air cylinder 12 lowers the electrical wire gripping unit 16 that is in the initial state. As a result, the two sets of grip parts 23 and 24 of the respective chuck means 26a and 26b are respectively disposed on the outside and on the inside of the individual electrical wires W that are held by the clamp means 6. At the same time, furthermore, the respective terminal guides 29 are disposed on the outside of the respective terminals C that are carried on the terminal carrying means 7.

Next, the first air chuck 18 causes the two outer claws 21a and 21b to move inward, and the second air chuck 19 causes the two inner claws 22a and 22b to move outward. As a result, the two sets of grip parts 23 and 24 of the respective chuck means 26a and 26b grip the respective electrical wires W.

Moreover, the terminal guide air cylinder 28 causes the two terminal guides 29 to move inward. Consequently, the recessed parts 30 of the respective terminal guides 29 support the terminals C attached to the respective electrical wires W.

Next, the vertical air cylinder 12 raises the electrical wire gripping unit 16. As a result, positioning in the vertical direction is performed between the terminals C attached to the electrical wires W that are gripped by the two sets of grip parts 23 and 24 of the respective chuck means 26a and 26b and specified terminal insertion holes F of the connector housing H disposed in the connector holding unit 3. In this case, the arrangement pitch of the electrical wires W that are gripped by the two sets of grip parts 23 and 24 of the two chuck means 26a and 26b of the electrical wire gripping unit 16 is still the arrangement pitch α , at which these two electrical wires W have been held by the clamp means 6.

Then, the air chuck 18 causes the two outer claws 21a and 21b to move further inward, thus causing the inner surface of the inner claw 22a of the first chuck means 26a and the inner surface of the inner claw 22b of the second chuck means 26b to contact each other. This changes the arrangement pitch of the two electrical wires W that are gripped by the two sets of grip parts 23 and 24 of the two chuck means 26a and 26b to 3 mm, which is the arrangement pitch β for allowing the simultaneous insertion of the terminals C attached to these two electrical wires W into specified terminal insertion holes F of the connector housing H. In this case, in synchronization with the change in the arrangement pitch of the electrical wires W gripped by the two sets of grip parts 23 and 24 of the two chuck means 26a and 26b, the terminal guide air cylinder 28 causes the two terminal guides 29 to move further inward, thus causing these terminal guides 29 to continue to support the terminals C attached to the respective electrical wires W.

Furthermore, the horizontal cylinder 14 causes the electrical wire gripping unit 16 to advance toward the connector housing H that is disposed in the connector holding unit 3. As a result, the terminals C attached to the two electrical wires W that are gripped by the two sets of grip parts 23 and 24 of the respective chuck means 26a and 26b are simultaneously inserted into specified terminal insertion holes F of the connector housing H in a temporary manner.

Following the temporary insertion of the terminals C into the terminal insertion holes F, the terminal guide air cylinder 28 causes the two terminal guides 29 to move outward. This releases the support of the terminals C attached to the respective electrical wires W by means of the respective terminal guides 29.

Then, the horizontal cylinder 14 causes the electrical wire gripping unit 16 to advance further toward the connector housing H. As a result, the terminals C attached to the respective electrical wires W are completely inserted into the specified terminal insertion holes F of the connector housing H.

Furthermore, following the insertion of the terminals C attached to the respective electrical wires W into the specified terminal insertion holes F of the connector housing H,

the gripping of the electrical wires W by the two sets of grip parts 23 and 24 of the respective chuck means 26a and 26b is released.

5 Moreover, the electrical wire gripping unit 16 is returned to the initial state and prepared for insertion of subsequent electrical wires W.

10 Thus, during wire harness production, the terminal insertion apparatus 1 enables the insertion of the terminals C attached to electrical wires W into terminal insertion holes F of the connector housing H for two electrical wires W at the same time.

Here, when gripping two electrical wires W and changing the arrangement pitch of these two gripped electrical wires W, it is ordinarily necessary to use a total of three drive systems, i.e., drive systems that respectively drive two gripping means for gripping the individual electrical wires W and a drive system that moves these two gripping means.
15 However, in the electrical wire gripping unit 16 of the terminal insertion apparatus 1, the air chuck 18 and air chuck 19 perform the gripping of two electrical wires W by means of the respective chuck means 26a and 26b and the changing of the arrangement pitch of these two electrical wires W. That is, the terminal insertion apparatus 1 makes it possible to grip two electrical wires and to change the arrangement pitch of the two gripped electrical wires by
20 using only two sets of drive systems.

In addition, with the terminal insertion apparatus 1, as a result of the recessed parts 30 of the respective terminal guides 29 supporting the terminals C attached to the respective electrical wires W, it is possible to prevent the occurrence of positional deviation between the
25 terminals C and terminal insertion holes F when the terminals C attached to the electrical wires W are inserted into the terminal insertion holes F of the connector housing H.

What Is Claimed Is:

1. A terminal insertion apparatus which inserts terminals attached to electrical wires that are held by a clamp means into specified terminal insertion holes of a connector housing, wherein
- 5 this apparatus comprises an electrical wire gripping unit having two sets of chuck means that respectively grip two of the electrical wires held by the clamp means at a specified arrangement pitch, and
- 10 the two chuck means change the arrangement pitch of the electrical wires that are gripped by these two chuck means from the specified arrangement pitch to an arrangement pitch at which the terminals attached to the electrical wires that are gripped by the two chuck means can be inserted into specified terminal insertion holes of the connector housing.
- 15 2. The terminal insertion apparatus according to Claim 1, wherein
- the electrical wire gripping unit comprises a pair of outer claws opened and closed by a first air chuck and a pair of inner claws opened and closed by a second air chuck,
- 20 one chuck means of the two chuck means is formed from one outer claw of the two outer claws and one inner claw of the two inner claws,
- the other chuck means of the two chuck means is formed from the other outer claw of the two outer claws and the other inner claw of the two inner claws, and
- the change in the arrangement pitch of the electrical wires that are gripped by the two chuck means is performed by the first air chuck causing the two outer claws to move inward, so that the two outer claws press the two inner claws inward.
- 25 3. The terminal insertion apparatus according to Claim 1 or 2, further comprising terminal guides that support the terminals attached to the electrical wires.