Tandem welding enables increased deposition rates and therefore improves economy of welding. Tandem welding also enables improved weld quality due to the possibility of assigning the leading and trailing electrode with different tasks. In order to allow the different electrodes to be assigned with different tasks the electrodes should preferably be sufficiently close to enable both electrodes to operate in a common single weld puddle. In the event the electrodes are separated to far from each other, the weld puddle generated by the early electrode may solidify before the second electrode has reached the puddle. In this event, the two electrodes more or less perform the task of two consecutive welding passes.

It is an object of the invention to provide a welding head that enables increased deposition rates, while maintaining a high welding quality.

SUMMARY OF THE INVENTION

This object is achieved by an electric arc welding head according to claim 1. The electric arc welding head according to the invention comprises a first contact device housing a first duct for feeding a first electrode and providing electrical contact between a first power source and said first electrode, a second contact device housing a second duct for feeding a second electrode and providing electrical contact between a second power source and said second electrode. The duct may be closed or be formed as recesses having an open side portion, as long as the ducts serves to secure and guide the electrodes and cold wire.

The electric arc welding device is thus a single integrated welding head housing a first duct and a second duct for two separate electrodes. Hence, the two electrodes may be positioned close to each other. Since the welding head includes two contact devices integrated in a single head, each contact device is electrically insulated from each other. Further the first and second ducts are arranged in parallel. This allows for provision of a controlled electrode distance during varying stick out. Stick out is the distance an

electrode protrudes from the contact device before burn off or melting occurs. The first and second ducts being arranged at a distance which allows for arcs between said first and second electrodes and a work piece to be welded will have an overlapping region. That is, the electrodes are so closely arranged such that the arcs from them will have an overlapping region. According to the invention the arc electric welding head further comprises a third insulated duct for feeding a cold wire into said overlapping region. A cold wire is a consumable wire which does not melt by the generation of an arc between the wire and the work piece. A cold wire may however be preheated by a current applied to it. It is however important that no arc is formed by the cold wire. Instead the wire is melted by the heat generated by the other electrodes which are connected to power sources for generation of arcs. It has been shown that by feeding the wire into the overlapping region a controlled melting of the cold wire can be achieved. A controlled melting of the cold wire is essential for the provision of a stable welding process. In the event the melting process is not controlled sufficiently the deposition rate from the cold electrode may vary substantially. Too slow melting may lead to that a solid piece of the electrode is detached from the wire and falls into the weld puddle. There is further a risk for that the wire penetrates into the puddle with a risk of that the wire is pushed to the bottom of the puddle. Such an event will inevitably lead to a great variation in the deposition rate. By feeding the cold wire into an overlapping region, it has been shown that the deposition rate can be held within an acceptable tolerance, such that a stable welding process can be achieved. The use of a cold wire has generated up to 50% increase in deposition rate on tests performed with same diameter on all wires (D2,5mm) welding with average parameters 850A 34V. With some parameter settings even up to 70% increase in deposition rate has been achieved.

According to a preferred embodiment the first, second and third ducts are arranged in parallel. By arranging the first, second and third ducts in parallel, a parallel arrangement of the electrodes and the cold wire is guaranteed. A parallel arrangement of the electrodes and the cold wire enables reduced

variation in distance between electrode tips or the distance between an electrode tip and the cold wire during variation in stick out from the respective electrode, the variation of the stick out of the cold wire will be reduced accordingly. A variation in electrode stick out as well as a variation in cold wire stick out leads to a variation of the magnitude of the overlapping region in which the cold electrode is introduced. As has been explained above, it is desirable to allow the electrode to melt in the arc plasma in order to obtain a stable deposition rate. A variation in stick out will always be present in any weld process. By arranging the first, second and third ducts in parallel, the variation of the magnitude of the overlapping region will be reduced and the variation of the deposition rate of the cold electrode will likewise be reduced.

Optionally, first and second ducts lie in a first plane and the third duct lies in a second plane which is orthogonal to the first plane. This enables a symmetric position of the cold wire in relation to the first and second electrodes. A symmetric positioning of the cold wire with respect to the electrodes allows for more stable arc plasma conditions at the location of the cold wire. Thus a more stable deposition rate of the cold electrode can be achieved.

Optionally, the first, second and third ducts all lie in a first plane. In this embodiment, the cold electrode is positioned in between the first and second electrode.

Optionally, first and second ducts have different diameters for feeding electrodes having different diameters. By allowing the electrodes to have different diameters, the freedom of controlling the welding process is increased.

Optionally, a distance between a centre of the third and first duct is less than 3 times the diameter of the first duct. Close mounting of the cold wire and first electrode ensures that the cold wire will melt in the arc plasma in a controlled fashion.

Optionally, as an additional requirement, a distance between a centre of the third and second duct is less than 3 times the diameter of the second duct. This mounting ensures that the cold wire will melt in the arc plasma in a controlled fashion.

The welding heads/torches should preferably be connected in a way that makes it impossible for the wire tips to move in relation to each other. This means that he torches should be connected in the lower part of the torch and preferably be located side by side with contact brackets separated only by in insulating body.

Optionally, the first contact device comprises a metallic body in which said first duct is formed, the second contact device comprises a metallic body in which said second duct is formed. Further a body of insulating material is separating said first contact device from said second contact device, wherein said third duct is formed in said body of insulating material. This construction of the welding head allows for a compact and yet rigid structure which allows close mounting of the first and second electrodes and of the cold wire.

Preferably, the first and second contact devices are each abutting on a respective side of said body of insulating material to form an integral body. This construction is particularly compact and rigid.

Optionally, the first and second contact device are clamped together with said body of insulating material to form an essentially cylindrical body, at least in a lower portion of said welding head at which apertures of said first, second and third ducts are located.

BRIEF DESCRIPTION OF DRAWINGS

The invention will be described in further detail below, with reference to appended drawings, where

Fig. 1 shows a front view of a welding head according to the invention,

Fig. 2 shows a side view of an embodiment of a welding head according to the invention being arranged to house a cold wire and two fusible continuously fed electrodes,

Fig. 3 a side view of another embodiment of a welding head according to the invention being arranged to house a central cold wire, two fusible continuously fed electrodes, and a leading cold electrode,

Fig.s 4 a – c show cross-sections taken at A-A, B-B; and C-C in figure 1,

Fig. 4d shows a cross section of an alternative embodiment, where a duct for a cold wire is shifted out from a plane extending through the ducts for the first and second electrodes,

Fig. 5 shows a cross-section taken at D-D in figure 2,

Fig. 6 shows a cross-section taken at E-E in figure 3,

Fig. 7 shows a welding head according to the invention arranged for welding a work piece.

Fig. 8 shows a first view of an example embodiment of an arc-welding welding arrangement for submerged arc welding,

Fig. 9 shows the arc-welding welding arrangement ot fig. 8 turned counterclockwise by 90[deg.],

Fig. 10 shows a perspective view or the arc-welding arrangement of Fig. 8,

Fig 11. shows an arc welding system.

halves 53a, 53b. The two halves 53a, 53b are connected together by an insulated connection 61. The insulated connection 61 can be formed by a pipe of insulating material. A screw 63 may be extending through the insulating pipe to secure the two halves 53a, 53b and the insulating body 15 together.

The carrier 53 may be formed by a first and a second plate 53a, 53b with an insulating body 15 interposed in between. The first and second plates are secured to each other via insulating elements 61. The insulating elements 61 may be formed by a pipe of insulating material extending through the first and second plates 53a, 53b. A screw 63 extends through the pipe of insulating material.

The carrier 53 may have a nose portion 65. The first and second retainer elements 43a, 43b are attached to the nose portion 65. The first and second retainer elements 43a, 43b are separated by the insulating body 15. The first and second retainer elements 43a, 43b are connected via an insulating element 61. Also this insulating element 61 may be formed by an insulating pipe through which a screw 63 may extend. Preferably insulating washers of insulating material are used to insulate the side walls of the welding head from the screws.

In figure 3 a side view of another embodiment of a welding head according to the invention being arranged to house a central cold wire, two fusible continuously fed electrodes, and a leading cold electrode. The welding head in figure 3 is based on a welding head as shown in figures 1 and 2 with an additional duct 69 for housing and feeding an additional cold wire. The additional cold wire is formed to be a leading wire by adding a retainer portion 69 having the additional duct 67 for the cold wire and an additional carrier portion 71 which houses a continuation for the additional duct. The additional duct 67 may be formed in a body of insulating material. The body of insulating material may be a monolithic body which may be plate shaped and have a

duct extending in a length direction. Alternatively, the duct may be formed as a recess in two plate shape parts forming the insulating body.

A welding head according to the invention may include a first plate element including a first contact device which is connected to a first retainer element. The first retainer element including a first retaining part carrying a first contact plate and a second retaining part carrying a second contact plate. The first and second retaining part being arranged to be movable with respect to each other for adjustment of a gap between said first and second contact plates and being biased towards each other by a resilient means. The welding head may further include a second contact device which is connected to a second retainer element. The second retainer including a first retaining part carrying a first contact plate and a second retaining part carrying a second contact plate, said first and second retaining part being arranged to be movable with respect to each other for adjustment of a gap between said first and second contact plates and being biased towards each other by a resilient means. The first and second retainers being separated by an insulating body housing a duct for a cold wire, and said first and second retainer elements being connected via an insulating element to form an integrated unit.

Further plate elements may be included such as the embodiment shown in figure 3, where a plate element of housing a duct for a cold wire integrated in an insulating body is formed. The insulating bodies may have contact devices which provides a clamping force to the cold wire in a similar manner as the contact devices for the electrodes as shown in figure 2. Alternatively, the insulating bodies are provided with ducts without clamping means. That is the insulating bodies will not include any moving parts but will be constituted by a monolithic body or a plurality of bodies in which a duct is formed. Such an insulating body may be used to separate two plate elements for housing electrodes.

Hence, more than 2 plate elements and 2 insulating bodies may be used.

Figure 4a shows a cross section taken at A – A in figure 1. The figure shows a first and a second plate element 53a, 53b which are separated by an insulating body 15. The first and second plate elements each house a duct for an electrode. The insulating body may be monolithic or be made by two parts where recesses are formed to create a duct 19. The first plate element, the second plate element and the insulating body are united by an insulating member 61.

Figure 4b shows a cross section taken at B – B in figure 1. The attachment portions of first and second retainer elements are connected to the nose portions of the first and second retainer elements. The attachment portions and the nose portions are separated by the insulating body 15 such that on one side of the insulating body are located the attachment portion of the first and second retainer parts of first retainer element and the nose portion of the first half of the carrier, and on the other side are located the attachment portion of the first and second retainer parts of second retainer element and the nose portion of the second half of the carrier. The insulating body includes a duct for the cold wire.

In figure 5 is shown a cross-section taken at D-D in figure 2. Here the first plate element with a first duct for an electrode, the second plate element with a second duct for an electrode and an insulating body are shown.

In figure 6 is shown a cross-section taken at E-E in figure 3. The figure includes an additional body of insulating material.

Generally the invention may also be related to an arc electric welding head comprising a first contact device housing a first duct for feeding a first electrode and providing electrical contact between a first power source and said first electrode, a second contact device housing a second duct for feeding a second electrode and providing electrical contact between a second power source and said second electrode, said first and second contact

devices being electrically insulated from each other, said first and second ducts being parallel, wherein first contact device is connected to a first retainer element including a first retaining part carrying a first contact plate and a second retaining part carrying a second contact plate, said first and second retaining parts being arranged to be movable with respect to each other for adjustment of a gap between said first and second contact plates and being biased towards each other by a resilient means, said second contact device is connected to a second retainer element including a first retaining part carrying a first contact plate and a second retaining part carrying a second contact plate, said first and second retaining parts being arranged to be movable with respect to each other for adjustment of a gap between said first and second contact plates and being biased towards each other by a resilient means, said first and second retainer being separated by an insulating body housing a duct for a cold wire, and said first and second retainer being connected via an insulating element to form an integrated unit.

Fig. 7 shows a welding head according to the invention arranged for welding a work piece 27. The welding head 1 propagates in a welding direction as indicated by arrow 25. The first and second electrodes, 7, 8 each have an arc 33. Each of the arcs 31, 33 are formed between the tip of the electrode and the work piece 27.

In arc welding an arc is present between the tip of the electrode and the work piece. The contact point of the arc at the working piece will be moving in a random manner. However, normally it is assumed that the arc is present within a cone shaped or parabolic surface from the tip of the consumable electrode to the work piece. The opening angle of the cone may vary from welding case to welding case. However, a normal opening angle may be around 30º. For this reason it is preferable to locate the cold wire such that it approaches the weld puddle in an essentially orthogonal direction thereto at an axial distance being less than L*cos15º from the consumable electrodes measured at the tip of the consumable electrode.

duct 5. Further, a distance between a centre of the third and second ducts 19, 13 may be less than 3 times the diameter of the second duct

Figures 8 to 10 depict different views of an example embodiment of an electric arc-welding welding arrangement 100 according to the invention for submerged arc welding which views are described in combination.
Along its longitudinal extension the electric arc-welding welding arrangement 100 comprises an arc welding head 160 at its lower end which during welding is in close proximity to the workpiece to be welded. The arc welding head 160 is of the type as described in connection to figures 1 – 7 and holds the electrodes 172, 174, 176 (Figs. 3, 4) of the electrode assembly 170 of the welding arrangement 100. The electrodes 172, 174, 176 exit the arc welding head 160 through outlets 162 at the lower end of the arc welding head 160 which faces the workpiece during the welding operation. The wire electrodes 172, 174, 176 may be fed from respective reservoirs such as coils (not shown) towards the arc welding arrangement 100.

The electrode assembly 170 comprises by way of example two fusible continuously-fed wire electrodes 172, 176 arranged in the arc welding head 160. The continuously fed wire electrodes 172, 176 are electrically isolated from each other by an insulating body in which a duct for a sold wire is situated. The arc welding head 160 comprises an electrically insulating portion 166 for an electrically insulated wire electrode 174.

The electrically insulating body is preferably an extra insulated wire conduit, for instance made of heat resistant material such as ceramics.

Above the arc welding head 160 a feeder device 150 is arranged which feeds an electrode towards the arc welding head 160. Typically, the feeder unit 150 comprises grooved wheels which move the wire electrode or the cold wire towards the arc welding head 160. The feeder unit may be arranged for feeding one of the electrodes or cold wire or both the electrodes and the cold wire. In the event the feeder unit feeds more than a single wire or electrode,

CLAIMS

1) An electric arc welding head (1) comprising a first contact device (3) housing a first duct (5) for feeding a first electrode (7) and providing electrical contact between a first power source (204) and said first electrode (7), a second contact device (11) housing a second duct (13) for feeding a second electrode (8) and providing electrical contact between a second power source (206) and said second electrode (8), said first and second contact devices (3, 11) being electrically insulated from each other, said first and second ducts (5, 13) being parallel, characterized in that said first and second ducts (5, 13) being arranged at a distance which allows for arcs (31, 33), between said first and second electrodes (7, 8) and a work piece (27) to be welded, to have an overlapping region (35), and in that said arc electric welding head (1) further comprises a third insulated duct (19) for feeding a cold wire (10) into said overlapping region (35).

2) An electric arc welding head according to claim 1, characterized in that said first contact device (3) is connected to a first retainer element (43a) including a first retaining part (43a1) carrying a first contact plate (49a) and a second retaining part (43a2) carrying a second contact plate 849b), said first and second retaining parts (43a1, 43a2) being arranged to be movable with respect to each other for adjustment of a gap between said first and second contact plates (49a, 49b) and being biased towards each other by a resilient means (55), said second contact (11) device is connected to a second retainer element (43b) including a first retaining part (43b1) carrying a first contact plate (49c) and a second retaining part (43b2) carrying a second contact plate (49d), said first and second retaining parts (43b1, 43b2) being arranged to be movable with respect to each other for adjustment of a gap between said first and second contact plates (49c, 49d) and being biased towards each other by a resilient means (55), said first and second retainer elements (3, 11) being separated by an insulating

body (15) housing a duct (19) for a cold wire (10), and said first and second retainer elements (3, 11) being connected via an insulated connection (61) to form an integrated unit.

3) An electric arc welding head according to claim 2, characterized in that said insulated connection (61) is a pipe extending through said first and second retainer elements (34a, 43b) and said insulating body (15).

4) An electric arc welding head according to claim 1, 2 or 3, characterized in that said first, second and third ducts (5, 13, 19) are arranged in parallel.

5) An electric arc welding head according to any of claims 1 - 4, characterized in that said first and second ducts (5, 13) lie in a first plane (21) and that said third duct (19) lies in a second plane (23) which is orthogonal to the first plane (21).

6) An electric arc welding head according to any of claims 1 - 4, characterized in that said first, second and third ducts (5, 13, 19) all lie in the first plane (21).

7) An electric arc welding head according to any of claims 1 – 6, characterized in that said third duct (19) is positioned in between said first and second ducts (5, 13).

8) An electric arc welding head according to any of claims 1 – 7, characterized in that said first and second ducts (5, 13) have different diameters for feeding electrodes (7, 8) having different diameters.

9) An electric arc welding head according to any of claims 1 – 8, characterized in that a distance between the centres of the third and first ducts (5, 13) is less than 3 times the diameter of the first duct (5).

10)An electric arc welding head according to claim 9, characterized in that a distance between the centres of the third and second ducts (19, 13) is less than 3 times the diameter of the second duct (13).

11)An electric arc welding head according to any of claims 1 – 10, characterized in that said first contact device (3) comprises a metallic body in which said first duct (5) is formed, said second contact device (11) comprises a metallic body in which said second duct (13) is formed, and in that a body (15) of insulating material is separating said first contact device (3) from said second contact device (11), wherein said third duct (19) is formed in said body (15) of insulating material.

12)An electric arc welding head according to claim 11, characterized in that said first and second contact devices (3, 11) are each abutting on a respective side of said body (15) of insulating material to form an integral body.

13)An electric arc welding head according to claim 12, characterized in that said first and second contact devices (3, 11) includes a first essentially semi cylindrical envelope surface forming an outer surface of said welding head (1), a second essentially flat side abutting said body (15) of insulating material, and an end face (170) at which an aperture of said duct is positioned.

14)An electric arc welding head according to claim 12 or 13, characterized in that said first and second contact devices (3, 11) are clamped together with said body (15) of insulating material to form an essentially cylindrical body, at least in a lower portion of said welding head at which apertures of said first, second and third ducts are located.

15)A welding system including a first wire feeder for feeding a first consumable electrode, a second wire feeder for feeding a second

consumable electrode, a third feeder for feeding a cold wire, a first power source connected to a first contact device for providing electrical contact between said first power source and said first electrode, a second power source connected to a second contact device for providing electrical contact between said second power source and said second electrode, characterized in that said first and second contact devices are arranged in an integral welding head for generation of an overlapping region between arcs from said first and second electrodes and a work piece to be welded, and in that said welding arrangement further comprises an insulated duct for feeding a cold wire into said overlapping region.

16)A welding system including a first wire feeder for feeding a first consumable electrode, a second wire feeder for feeding a second consumable electrode, a third feeder for feeding a cold wire, a first power source connected to a first contact device for providing electrical contact between said first power source and said first electrode, a second power source connected to a second contact device for providing electrical contact between said second power source and said second electrode, characterized in that welding system includes a welding head according to any of claims 1 – 15.

Tandem welding enables increased deposition rates and therefore improves economy of welding. Tandem welding also enables improved weld quality due to the possibility of assigning the leading and trailing electrode with different tasks. In order to allow the different electrodes to be assigned with different tasks the electrodes should preferably be sufficiently close to enable both electrodes to operate in a common single weld puddle. In the event the electrodes are separated to far from each other, the weld puddle generated by the early electrode may solidify before the second electrode has reached the puddle. In this event, the two electrodes more or less perform the task of two consecutive welding passes.

Implementation of the techniques disclosed herein may provide a welding head that enables increased deposition rates, while maintaining a high welding quality.

SUMMARY OF THE INVENTION

The invention is defined in the independent claims. Some optional features of the invention are defined in the dependent claims. In one configuration, the electric arc welding head comprises a first contact device housing a first duct for feeding a first electrode and providing electrical contact between a first power source and said first electrode, a second contact device housing a second duct for feeding a second electrode and providing electrical contact between a second power source and said second electrode. The duct may be closed or be formed as recesses having an open side portion, as long as the ducts serves to secure and guide the electrodes and cold wire.

The electric arc welding device is thus a single integrated welding head housing a first duct and a second duct for two separate electrodes. Hence, the two electrodes may be positioned close to each other. Since the welding head includes two contact devices integrated in a single head, each contact device is electrically insulated from each other. Further the first and second ducts are arranged in parallel. This allows for provision of a controlled electrode distance during varying stick out. Stick out is the distance an

electrode protrudes from the contact device before burn off or melting occurs. The first and second ducts being arranged at a distance which allows for arcs between said first and second electrodes and a work piece to be welded will have an overlapping region. That is, the electrodes are so closely arranged such that the arcs from them will have an overlapping region. The arc electric welding head may further comprise a third insulated duct for feeding a cold wire into said overlapping region. A cold wire is a consumable wire which does not melt by the generation of an arc between the wire and the work piece. A cold wire may however be preheated by a current applied to it. It is however important that no arc is formed by the cold wire. Instead the wire is melted by the heat generated by the other electrodes which are connected to power sources for generation of arcs. It has been shown that by feeding the wire into the overlapping region a controlled melting of the cold wire can be achieved. A controlled melting of the cold wire is essential for the provision of a stable welding process. In the event the melting process is not controlled sufficiently the deposition rate from the cold electrode may vary substantially. Too slow melting may lead to that a solid piece of the electrode is detached from the wire and falls into the weld puddle. There is further a risk for that the wire penetrates into the puddle with a risk of that the wire is pushed to the bottom of the puddle. Such an event will inevitably lead to a great variation in the deposition rate. By feeding the cold wire into an overlapping region, it has been shown that the deposition rate can be held within an acceptable tolerance, such that a stable welding process can be achieved. The use of a cold wire has generated up to 50% increase in deposition rate on tests performed with same diameter on all wires (D2,5mm) welding with average parameters 850A 34V. With some parameter settings even up to 70% increase in deposition rate has been achieved.

According to a preferred embodiment the first, second and third ducts are arranged in parallel. By arranging the first, second and third ducts in parallel, a parallel arrangement of the electrodes and the cold wire is guaranteed. A parallel arrangement of the electrodes and the cold wire enables reduced

variation in distance between electrode tips or the distance between an electrode tip and the cold wire during variation in stick out from the respective electrode, the variation of the stick out of the cold wire will be reduced accordingly. A variation in electrode stick out as well as a variation in cold wire stick out leads to a variation of the magnitude of the overlapping region in which the cold electrode is introduced. As has been explained above, it is desirable to allow the electrode to melt in the arc plasma in order to obtain a stable deposition rate. A variation in stick out will always be present in any weld process. By arranging the first, second and third ducts in parallel, the variation of the magnitude of the overlapping region will be reduced and the variation of the deposition rate of the cold electrode will likewise be reduced.

Optionally, first and second ducts lie in a first plane and the third duct lies in a second plane which is orthogonal to the first plane. This enables a symmetric position of the cold wire in relation to the first and second electrodes. A symmetric positioning of the cold wire with respect to the electrodes allows for more stable arc plasma conditions at the location of the cold wire. Thus a more stable deposition rate of the cold electrode can be achieved.

Optionally, the first, second and third ducts all lie in a first plane. In this embodiment, the cold electrode is positioned in between the first and second electrode.

Optionally, first and second ducts have different diameters for feeding electrodes having different diameters. By allowing the electrodes to have different diameters, the freedom of controlling the welding process is increased.

A distance between a centre of the third and first duct is less than 3 times the diameter of the first duct. Close mounting of the cold wire and first electrode ensures that the cold wire will melt in the arc plasma in a controlled fashion.

A distance between a centre of the third and second duct is less than 3 times the diameter of the second duct. This mounting ensures that the cold wire will melt in the arc plasma in a controlled fashion.

The welding heads/torches should preferably be connected in a way that makes it impossible for the wire tips to move in relation to each other. This means that he torches should be connected in the lower part of the torch and preferably be located side by side with contact brackets separated only by in insulating body.

Optionally, the first contact device comprises a metallic body in which said first duct is formed, the second contact device comprises a metallic body in which said second duct is formed. Further a body of insulating material is separating said first contact device from said second contact device, wherein said third duct is formed in said body of insulating material. This construction of the welding head allows for a compact and yet rigid structure which allows close mounting of the first and second electrodes and of the cold wire.

Preferably, the first and second contact devices are each abutting on a respective side of said body of insulating material to form an integral body. This construction is particularly compact and rigid.

Optionally, the first and second contact device are clamped together with said body of insulating material to form an essentially cylindrical body, at least in a lower portion of said welding head at which apertures of said first, second and third ducts are located.

BRIEF DESCRIPTION OF DRAWINGS

The invention will be described in further detail below, with reference to appended drawings, where

Fig. 1 shows a front view of a welding head,

Fig. 2 shows a side view of an embodiment of a welding head being arranged to house a cold wire and two fusible continuously fed electrodes,

Fig. 3 a side view of another embodiment of a welding head being arranged to house a central cold wire, two fusible continuously fed electrodes, and a leading cold electrode,

Fig.s 4 a - c show cross-sections taken at A-A; B-B; and C-C in figure 1,

Fig. 4d shows a cross section of an alternative embodiment, where a duct for a cold wire is shifted out from a plane extending through the ducts for the first and second electrodes,

Fig. 5 shows a cross-section taken at D-D in figure 2,

Fig. 6 shows a cross-section taken at E-E in figure 3,

Fig. 7 shows a welding head arranged for welding a work piece.

Fig. 8 shows a first view of an example embodiment of an arc-welding welding arrangement for submerged arc welding,

Fig. 9 shows the arc-welding welding arrangement of fig. 8 turned counterclockwise by 90[deg.],

Fig. 10 shows a perspective view or the arc-welding arrangement of Fig. 8,

Fig 11. shows an arc welding system.

halves 53a, 53b. The two halves 53a, 53b are connected together by an insulated connection 61. The insulated connection 61 can be formed by a pipe of insulating material. A screw 63 may be extending through the insulating pipe to secure the two halves 53a, 53b and the insulating body 15 together.

The carrier 53 may be formed by a first and a second plate 53a, 53b with an insulating body 15 interposed in between. The first and second plates are secured to each other via insulating elements 61. The insulating elements 61 may be formed by a pipe of insulating material extending through the first and second plates 53a, 53b. A screw 63 extends through the pipe of insulating material.

The carrier 53 may have a nose portion 65. The first and second retainer elements 43a, 43b are attached to the nose portion 65. The first and second retainer elements 43a, 43b are separated by the insulating body 15. The first and second retainer elements 43a, 43b are connected via an insulating element 61. Also this insulating element 61 may be formed by an insulating pipe through which a screw 63 may extend. Preferably insulating washers of insulating material are used to insulate the side walls of the welding head from the screws.

In figure 3 a side view of another embodiment of a welding head being arranged to house a central cold wire, two fusible continuously fed electrodes, and a leading cold electrode. The welding head in figure 3 is based on a welding head as shown in figures 1 and 2 with an additional duct 69 for housing and feeding an additional cold wire. The additional cold wire is formed to be a leading wire by adding a retainer portion 69 having the additional duct 67 for the cold wire and an additional carrier portion 71 which houses a continuation for the additional duct. The additional duct 67 may be formed in a body of insulating material. The body of insulating material may be a monolithic body which may be plate shaped and have a

duct extending in a length direction. Alternatively, the duct may be formed as a recess in two plate shape parts forming the insulating body.

A welding head may include a first plate element including a first contact device which is connected to a first retainer element. The first retainer element including a first retaining part carrying a first contact plate and a second retaining part carrying a second contact plate. The first and second retaining part being arranged to be movable with respect to each other for adjustment of a gap between said first and second contact plates and being biased towards each other by a resilient means. The welding head may further include a second contact device which is connected to a second retainer element. The second retainer including a first retaining part carrying a first contact plate and a second retaining part carrying a second contact plate, said first and second retaining part being arranged to be movable with respect to each other for adjustment of a gap between said first and second contact plates and being biased towards each other by a resilient means. The first and second retainers are separated by an insulating body housing a duct for a cold wire, and said first and second retainer elements being connected via an insulating element to form an integrated unit.

Further plate elements may be included such as the embodiment shown in figure 3, where a plate element of housing a duct for a cold wire integrated in an insulating body is formed. The insulating bodies may have contact devices which provide a clamping force to the cold wire in a similar manner as the contact devices for the electrodes as shown in figure 2. Alternatively, the insulating bodies are provided with ducts without clamping means. That is the insulating bodies will not include any moving parts but will be constituted by a monolithic body or a plurality of bodies in which a duct is formed. Such an insulating body may be used to separate two plate elements for housing electrodes.

Hence, more than 2 plate elements and 2 insulating bodies may be used.

Figure 4a shows a cross section taken at A - A in figure 1. The figure shows a first and a second plate element 53a, 53b which are separated by an insulating body 15. The first and second plate elements each house a duct for an electrode. The insulating body may be monolithic or be made by two parts where recesses are formed to create a duct 19. The first plate element, the second plate element and the insulating body are united by an insulating member 61.

Figure 4b shows a cross section taken at B - B in figure 1. The attachment portions of first and second retainer elements are connected to the nose portions of the first and second retainer elements. The attachment portions and the nose portions are separated by the insulating body 15 such that on one side of the insulating body are located the attachment portion of the first and second retainer parts of first retainer element and the nose portion of the first half of the carrier, and on the other side are located the attachment portion of the first and second retainer parts of second retainer element and the nose portion of the second half of the carrier. The insulating body includes a duct for the cold wire.

In figure 5 is shown a cross-section taken at D-D in figure 2. Here the first plate element with a first duct for an electrode, the second plate element with a second duct for an electrode and an insulating body are shown.

In figure 6 is shown a cross-section taken at E-E in figure 3. The figure includes an additional body of insulating material.

In another configuration, there is provided an arc electric welding head comprising a first contact device housing a first duct for feeding a first electrode and providing electrical contact between a first power source and said first electrode, a second contact device housing a second duct for feeding a second electrode and providing electrical contact between a second power source and said second electrode, said first and second contact

devices being electrically insulated from each other, said first and second ducts being parallel, wherein first contact device is connected to a first retainer element including a first retaining part carrying a first contact plate and a second retaining part carrying a second contact plate, said first and second retaining parts being arranged to be movable with respect to each other for adjustment of a gap between said first and second contact plates and being biased towards each other by a resilient means, said second contact device is connected to a second retainer element including a first retaining part carrying a first contact plate and a second retaining part carrying a second contact plate, said first and second retaining parts being arranged to be movable with respect to each other for adjustment of a gap between said first and second contact plates and being biased towards each other by a resilient means, said first and second retainer being separated by an insulating body housing a duct for a cold wire, and said first and second retainer being connected via an insulating element to form an integrated unit.

Fig. 7 shows a welding head arranged for welding a work piece 27. The welding head 1 propagates in a welding direction as indicated by arrow 25. The first and second electrodes, 7, 8 each have an arc 33. Each of the arcs 31, 33 are formed between the tip of the electrode and the work piece 27.

In arc welding an arc is present between the tip of the electrode and the work piece. The contact point of the arc at the working piece will be moving in a random manner. However, normally it is assumed that the arc is present within a cone shaped or parabolic surface from the tip of the consumable electrode to the work piece. The opening angle of the cone may vary from welding case to welding case. However, a normal opening angle may be around 30°. For this reason it is preferable to locate the cold wire such that it approaches the weld puddle in an essentially orthogonal direction thereto at an axial distance being less than L*cos15° from the consumable electrodes measured at the tip of the consumable electrode.

duct 5. Further, a distance between a centre of the third and second ducts 19, 13 may be less than 3 times the diameter of the second duct.

Figures 8 to 10 depict different views of an example embodiment of an electric arc-welding welding arrangement 100 for submerged arc welding which views are described in combination.

Along its longitudinal extension the electric arc-welding welding arrangement 100 comprises an arc welding head 160 at its lower end which during welding is in close proximity to the workpiece to be welded. The arc welding head 160 is of the type as described in connection to figures 1 - 7 and holds the electrodes 172, 174, 176 (Figs. 3, 4) of the electrode assembly 170 of the welding arrangement 100. The electrodes 172, 174, 176 exit the arc welding head 160 through outlets 162 at the lower end of the arc welding head 160 which faces the workpiece during the welding operation. The wire electrodes 172, 174, 176 may be fed from respective reservoirs such as coils (not shown) towards the arc welding arrangement 100.

The electrode assembly 170 comprises by way of example two fusible continuously-fed wire electrodes 172, 176 arranged in the arc welding head 160. The continuously fed wire electrodes 172, 176 are electrically isolated from each other by an insulating body in which a duct for a sold wire is situated. The arc welding head 160 comprises an electrically insulating portion 166 for an electrically insulated wire electrode 174.

The electrically insulating body is preferably an extra insulated wire conduit, for instance made of heat resistant material such as ceramics.

Above the arc welding head 160 a feeder device 150 is arranged which feeds an electrode towards the arc welding head 160. Typically, the feeder unit 150 comprises grooved wheels which move the wire electrode or the cold wire towards the arc welding head 160. The feeder unit may be arranged for feeding one of the electrodes or cold wire or both the electrodes and the cold wire. In the event the feeder unit feeds more than a single wire or electrode,

CLAIMS

1) An electric arc welding head (1) comprising a first contact device (3) housing a first duct (5) for feeding a first electrode (7) and for providing electrical contact between a first power source (204) and said first electrode (7), a second contact device (11) housing a second duct (13) for feeding a second electrode (8) and for providing electrical contact between a second power source (206) and said second electrode (8), said first and second contact devices (3, 11) being electrically insulated from each other, said first and second ducts (5, 13) being parallel, characterized in that said first and second ducts (5, 13) being arranged at a distance which allows for arcs (31 , 33), between said first and second electrodes (7, 8) and a work piece (27) to be welded, to have an overlapping region (35), and in that said electric arc welding head (1) further comprises a third insulated duct (19) for feeding a cold wire (10) into said overlapping region (35, characterized in that a distance between centres of the third and first ducts (5, 19) is less than 3 times a diameter of the first duct (5) and a distance between centres of the third and second ducts (19, 13) is less than 3 times a diameter of the second duct (13).

2) An electric arc welding head according to claim 1, characterized in that said first contact device (3) is connected to a first retainer element (43a) including a first retaining part (43a1) carrying a first contact plate (49a) and a second retaining part (43a2) carrying a second contact plate 849b), said first and second retaining parts (43a1 , 43a2) being arranged to be movable with respect to each other for adjustment of a gap between said first and second contact plates (49a, 49b) and being biased towards each other by a resilient means (55), said second contact (11) device is connected to a second retainer element (43b) including a first retaining part (43b1) carrying a first contact plate (49c) and a second retaining part (43b2) carrying a second contact plate (49d), said first and second retaining parts (43b1 , 43b2) being arranged to be movable with respect to each other for adjustment of a gap between said first and second contact plates (49c, 49d) and

being biased towards each other by a resilient means (55), said first and second retainer elements (3, 11) being separated by an insulating body (15) housing a duct (19) for a cold wire (10), and said first and second retainer elements (3, 11) being connected via an insulated connection (61) to form an integrated unit.

3) An electric arc welding head according to claim 2, characterized in that said insulated connection (61) is a pipe extending through said first and second retainer elements (34a, 43b) and said insulating body (15).

4) An electric arc welding head according to claim 1, 2 or 3, characterized in that said first, second and third ducts (5, 13, 19) are arranged in parallel.

5) An electric arc welding head according to any of claims 1 - 4, characterized in that said first and second ducts (5, 13) lie in a first plane (21) and that said third duct (19) lies in a second plane (23) which is orthogonal to the first plane (21).

6) An electric arc welding head according to any of claims 1 - 4, characterized in that said first, second and third ducts (5, 13, 19) all lie in the first plane (21).

7) An electric arc welding head according to any of claims 1 - 6, characterized in that said third duct (19) is positioned in between said first and second ducts (5, 13).

8) An electric arc welding head according to any of claims 1 - 7, characterized in that said first and second ducts (5, 13) have different diameters for feeding electrodes (7, 8) having different diameters.

9) An electric arc welding head according to any of claims 1 - 8,

characterized in that said first contact device (3) comprises a metallic body in which said first duct (5) is formed, said second contact device (11) comprises a metallic body in which said second duct (13) is formed, and in that a body (15) of insulating material is separating said first contact device (3) from said second contact device (1 1), wherein said third duct (19) is formed in said body (15) of insulating material.

10) An electric arc welding head according to claim 9 , characterized in that said first and second contact devices (3, 11) are each abutting on a respective side of said body (15) of insulating material to form an integral body.

11) An electric arc welding head according to claim 10, characterized in that said first and second contact devices (3, 11) includes a first essentially semi cylindrical envelope surface forming an outer surface of said welding head (1), a second essentially flat side abutting said body (15) of insulating material, and an end face (170) at which an aperture of said duct is positioned.

12) An electric arc welding head according to claim 10 or 11, characterized in that said first and second contact devices (3, 11) are clamped together with said body (15) of insulating material to form an essentially cylindrical body, at least in a lower portion of said welding head at which apertures of said first, second and third ducts are located.

13) A welding system (100) including a first wire feeder (210) for feeding a first consumable electrode (7), a second wire feeder (212) for feeding a second consumable electrode (8), a third feeder (214) for feeding a cold wire (10), a first contact device (3) arranged for connection to a first power source (204), the first contact device (3) housing

a first duct (5) for providing electrical contact between said first power source (204) and said first electrode (7), a second contact device (11) arranged for connection to a second power source (206), the second contact device (11) housing a second duct (13) for providing electrical contact between said second power source (206) and said second electrode (8), characterized in that said first and second contact devices (3,11) are arranged in an integral welding head (1) for generation of an overlapping region (35) between arcs from said first and second electrodes (7,8) and a work piece (27) to be welded, and in that said welding arrangement further comprises an insulated third duct (19) for feeding the cold wire into said overlapping region (35), further characterized in that a distance between centres of the third and first ducts (5, 19) is less than 3 times a diameter of the first duct (5) and a distance between centres of the third and second ducts (19, 13) is less than 3 times a diameter of the second duct (13).

14) A welding system (100) including a first wire feeder (210) for feeding a first consumable electrode (7), a second wire feeder (212) for feeding a second consumable electrode (8), a third feeder (214) for feeding a cold wire (10), a first contact device (3) for connection to a first power source (204), the first contact device (3) being arranged for providing electrical contact between said first power source (204) and said first electrode (8), a second contact device (11) for connection to a second power source (206), the second device (11) being arranged for providing electrical contact between said second power source (206) and said second electrode (8), characterized in that welding system (100) includes a welding head according to any of claims 1 – 12.