The invention is a sensor (15) for welding and/or cutting systems comprising a generator (4), a welding and/or cutting torch (1) and a connection element (40) comprising one or more power supply cables (1b) of the torch and/or one or more control cables of the torch; the sensor (15) is such that it is suited to detect the passage of current in at least one of said one or more cables of the connection element (40); the sensor (15) is such that it comprises a ferromagnetic circuit (19) that at least partially envelops said at least one of said one or more cables of the connection element (40) and a Hall sensor (18). The invention furthermore concerns a welding and/or cutting unit comprising a current sensor (15).
SENSOR FOR DETECTING/MEASURING THE WELDING AND/OR CUTTING CURRENT IN A WELDING AND/OR CUTTING SYSTEM.

TECHNICAL FIELD OF THE INVENTION

The present invention concerns the field of welding systems. More particularly, the present invention concerns the field of sensors for welding and/or cutting systems. In greater detail, the present invention concerns the field of welding and/or cutting current sensors for welding and/or cutting systems.

PRIOR ART

Several welding and/or cutting current sensors for welding and/or cutting systems are known in the art. In many cases, however, the known sensors pose some drawbacks. They are often cumbersome and therefore difficult to install and expensive.

Therefore, it is the object of the present invention to provide a welding and/or cutting system comprising a welding and/or cutting current sensor that at least partially solves the problems mentioned above. In particular, it is the object of the present invention to provide a welding system in which the welding and/or cutting current sensor is small-sized, easy to install and economical to produce.

SUMMARY OF THE INVENTION

The present invention is based on the idea of providing a current sensor for welding and/or cutting systems that comprises a small-sized Hall probe.

According to a further embodiment of the present invention, the latter provides a sensor for welding and/or cutting systems comprising a generator, a welding and/or cutting torch and a connection element comprising one or more power supply cables of the torch and/or one or more control cables of the torch; the sensor is such that it is suited to detect the passage of current in at least one of said one or more cables of the connection element; the sensor is such as to comprise a ferromagnetic circuit that at least partially envelops said at least one of said one or more cables of the connection element and a Hall sensor.

The sensor according to the present invention is precise, occupies a small space and makes it possible to detect the passage of welding current and to measure its intensity.

According to a further embodiment of the present invention, the latter provides a sensor that is such as to be suited to measure the intensity of the current that flows through said one or more power supply cables.

According to a further embodiment of the present invention, the latter provides a
sensor in which the ferromagnetic circuit comprises one or more C-shaped elements.
According to a further embodiment of the present invention, the latter provides a current sensor in which said one or more C-shaped elements at least partially envelop said one or more power supply cables of the torch or parts of the torch body.
According to a further embodiment of the present invention, the latter provides a current sensor that is such as to comprise a container where the ferromagnetic circuit can be closed.
According to a further embodiment of the present invention, the latter provides a current sensor that is suited to be connected to a microprocessor included in the welding system, in such a way as to signal to the first microprocessor the presence of current flowing through said one or more cables of said connection element.
According to a further embodiment of the present invention, the latter provides a welding and/or cutting unit comprising a welding and/or cutting torch and a connection element comprising one or more power supply cables of the torch; the welding unit is such that it comprises a current sensor of the type described above.
According to a further embodiment of the present invention, the latter provides a welding and/or cutting unit comprising a microprocessor suited to automatically recognize the operating mode of the torch, for example 2T or 4T mode, based on the signal received from the current sensor and on the position of the push button.
According to a further embodiment of the present invention, the latter provides a welding and/or cutting system comprising a generator, a welding and/or cutting torch, a connection element comprising one or more power supply cables of the torch and a protection unit; the welding system is such that it comprises a current sensor as described above and such that it comprises a welding unit of the type described above.
According to a further embodiment of the present invention, the latter provides a welding system that is such as to comprise a microprocessor suited to automatically recognize the operating mode of the torch, for example 2T or 4T mode, based on the signal received from the current sensor and on the position of the push button.
According to a further embodiment of the present invention, the latter provides a
welding and/or cutting system in which the darkening of a protection screen, for example an LCD filter, included in the protection unit, is a function of the current measured by the current sensor.

According to a further embodiment of the present invention, the latter provides a control system for welding and/or cutting systems of the type comprising a generator, a welding and/or cutting torch suited to be connected to the generator through a connection element, a protection unit comprising a protection screen that can be darkened, for example an LCD filter; the control system is such that it comprises first transmission/reception means of the Bluetooth® type cooperating with the protection unit and/or with the protection screen, in order to respectively control the darkening of the protection screen and/or the start/stop of the welding and/or cutting arc.

According to a further embodiment of the present invention, the latter provides a control system in which the transmission/reception means are suited to exchange information with any Bluetooth® device, both inside the welding system, for example another transmission/reception means of the Bluetooth® type, and outside the welding system, for example a PC, a tablet or similar devices.

According to a further embodiment of the present invention, the latter provides a control system comprising a control panel that in turn comprises warning lights suited to signal the status of the control system and push buttons for the configuration of said control system.

According to a further embodiment of the present invention, the latter provides a control system comprising a microprocessor.

According to a further embodiment of the present invention, the latter provides a control system in which the microprocessor comprises an interface for connection with the torch, comprising at least one low-pass filter for each one of the one or more control cables.

According to a further embodiment of the present invention, the latter provides a control system in which the low-pass filter is of the capacitive type.

According to a further embodiment of the present invention, the latter provides a control system in which the microprocessor comprises an interface for connection with the generator, comprising at least one galvanic isolation element for each one of the one or more control cables.

According to a further embodiment of the present invention, the latter provides a control system in which the galvanic isolation element comprises a relay in the
solid state and/or an optoisolator, for example a photodiode/photocell pair.
According to a further embodiment of the present invention, the latter provides a control system comprising a current sensor suited to measure the passage of current in the one or more power supply cables.

According to a further embodiment of the present invention, the latter provides a welding and/or cutting unit comprising a welding and/or cutting torch suited to be connected to a generator through a connection element; the welding unit is such that it comprises a control system for welding and/or cutting systems of the type described above.

According to a further embodiment of the present invention, the latter provides a welding and/or cutting unit in which the control system is positioned between a connector and a cable bundle included in the connection element.

According to a further embodiment of the present invention, the latter provides a welding and/or cutting system comprising a generator, a welding and/or cutting unit suited to be connected to the generator through a connection element and a protection unit comprising a protection screen; the welding system is such that it comprises a control system of the type described above or in which the welding unit is of the type described above.

According to a further embodiment of the present invention, the latter provides a welding and/or cutting system in which the protection unit comprises second transmission/reception means of the Bluetooth® type, suited to transmit/receive data to/from the first transmission/reception means included in the control system.

According to a further embodiment of the present invention, the latter provides a welding and/or cutting system in which the protection unit comprises optical sensors suited to detect the radiation emitted by the welding arc.

According to a further embodiment of the present invention, the latter provides a welding and/or cutting system in which the protection unit comprises a second microprocessor.

According to a further embodiment of the present invention, the latter provides a welding and/or cutting system in which the protection unit comprises a protection screen control system suited to communicate the darkening voltage to the LCD
filter of the protection screen.

According to a further embodiment of the present invention, the latter provides a welding and/or cutting system in which the protection unit comprises transducer means, for example a microphone, an acoustic diffuser or similar devices.

According to a further embodiment of the present invention, the latter provides a welding and/or cutting system in which the control panel of the control system comprises an on/off button suited to switch the control system on/off, such that, if in the shutdown configuration, it sets the system back to a traditional operating mode, wherein the torch is directly connected to the generator bypassing the control circuit.

According to a further embodiment of the present invention, the latter provides a welding and/or cutting system comprising a generator, a welding and/or cutting torch and a protection unit comprising a protection screen, for example an LCD filter; the system is such that the opening time of the protection screen, at the end of the welding/cutting operation, is calculated by a microprocessor included in the welding and/or cutting system, based on the welding and/or cutting time.

According to a further embodiment of the present invention, the latter provides a welding and/or cutting system that is such that the welding time is calculated by a first microprocessor, included in the welding system, based on the welding current detected/measured by a current sensor included in the welding system.

According to a further embodiment of the present invention, the latter provides a welding and/or cutting system that is such that the welding time is calculated by a second microprocessor, included in the protection unit, based on the duration of the radiation emitted by the welding and/or cutting arc and detected by optical sensors included in the protection unit.

According to a further embodiment of the present invention, the latter provides a welding and/or cutting system that is such that the opening time never exceeds a preset time, for example 1 sec.

According to a further embodiment of the present invention, the latter provides a welding and/or cutting system comprising a generator, a welding and/or cutting unit and a protection unit comprising a protection screen; the welding system is such that it comprises a data collection/transmission unit.

According to a further embodiment of the present invention, the latter provides a welding and/or cutting system that is such that the data collection/transmission unit comprises one or more sensors suited to measure the quantities of interest
and a data collection/transmission system.
According to a further embodiment of the present invention, the latter provides a welding and/or cutting system that is such that the data collection/transmission system is included in the welding and/or cutting unit.

According to a further embodiment of the present invention, the latter provides a welding and/or cutting system that is such that the sensors comprise a flow rate sensor suited to measure the flow rate of a welding and/or cooling fluid/gas.

According to a further embodiment of the present invention, the latter provides a welding and/or cutting system that is such that the sensor comprises a differential pressure sensor and/or an absolute pressure sensor and/or a volumetric flow sensor.

According to a further embodiment of the present invention, the latter provides a welding and/or cutting system that is such that the sensors comprise a sensor suited to measure the speed of the welding wire.

According to a further embodiment of the present invention, the latter provides a welding and/or cutting system that is such that the sensors comprise one or more sensors suited to measure the temperature and/or the flow rate of the liquid present in a cooling circuit included in the system.

According to a further embodiment of the present invention, the latter provides a welding and/or cutting system that is such that said one or more sensors comprise a differential pressure sensor and/or an absolute pressure sensor and/or a volumetric flow sensor and/or a ptc or ntc sensor.

According to a further embodiment of the present invention, the latter provides a welding and/or cutting system that is such that the data collection/transmission system comprises software suited to process the data received from the sensors.

According to a further embodiment of the present invention, the latter provides a welding and/or cutting system that is such as to be suited to be connected, via a wired or wireless connection, to devices located outside the system, for example a printing unit.

According to a further embodiment of the present invention, the latter provides a welding and/or cutting system that is such that the data collection/transmission system is connected, via a wired or wireless connection, to first transmission/reception means included in the welding and/or cutting unit and/or to second transmission/reception means included in the protection unit.

According to a further embodiment of the present invention, the latter provides a welding and/or cutting system that is such that the data collection/transmission system is connected, via a wired or wireless connection, to first transmission/reception means included in the welding and/or cutting unit and/or to second transmission/reception means included in the protection unit.
welding and/or cutting system in which the protection unit comprises means for
displaying and/or listening to the data originating from the data
collection/transmission unit.
According to a further embodiment of the present invention, the latter provides a
control system in which the connection element comprises a cable bundle
comprising one or more control cables of the torch and one or more power supply
cables of the torch; the cable bundle is suited to connect the torch to the
connector and the connector is suited to connect the torch to the generator.
According to a further embodiment of the present invention, the latter provides a
control system that is positioned between the connector and the cable bundle that
connects the connector to the torch.

**BRIEF DESCRIPTION OF THE DRAWINGS**
The present invention will be described with reference to the attached drawings,
in which the same reference numbers and/or signs indicate the same and/or
similar and/or corresponding parts of the system.
Figure 1 schematically shows a welding and/or cutting system according to an
embodiment of the present invention.
Figures 2A and 2B schematically show a detail of the welding system shown in
Figure 1.
Figure 3 schematically shows a further detail of the welding system shown in
Figure 1, in 3D (Figure 3A) and in a sectional view (Figure 3B).
Figure 4 schematically shows a further detail of the welding system shown in
Figure 1.
Figure 5 schematically shows a further detail of the welding system shown in
Figure 1.

**DETAILED DESCRIPTION OF THE INVENTION**
The present invention is described here below with reference to specific
embodiments illustrated in the attached drawings. However, the present invention
is not limited to the specific embodiments disclosed in the following detailed
description and illustrated in the figures, but, rather, the embodiments described
below simply exemplify several aspects of the present invention, the purpose and
the scope of which are defined in the claims.
Further modifications and variants of the present invention will be clear to the
expert in the art.
Figure 1 schematically shows a welding and/or cutting system according to an
embodiment of the present invention.
The welding and/or cutting system according to the present invention may comprise welding machines of the MMA, TIG, MIG/MAG type, plasma welding machines or with electrodes with or without protective gas. In order to simplify the explanation, the description provided here below makes reference to a welding system, but it applies as well to a cutting system.
The welding system shown in the figure may comprise three fundamental units: a main unit, a protection unit and a data collection/transmission unit.
The main unit comprises a generator 4 to which a gas cylinder 28 and/or a cooling circuit is/are connected. The main unit furthermore comprises a welding unit that in turn comprises a welding torch 1, a ground cable 5 that connects the generator 4 to the element to be welded M and a connection element 40.
The connection element 40 comprises a connector 30, a cable bundle 11. pipes for the passage of water in case a cooling circuit for the torch 1 is provided, and pipes for the passage of pressurized air in the case of a torch for plasma cutting or for the passage of a gas or a gas mixture in the case where the welding system is designed to include the use of the latter.
The cable bundle 11 connects the torch 1 to the connector 30 and the connector 30 connects the cable bundle 11, and therefore the torch 1, to the generator 4. The cable bundle 11 furthermore comprises at least one or more control cables 11a of the torch and one or more power supply cables 11b of the torch 1, not shown in the figure.
The welding torch 1 comprises a push button 8 for starting/stopping the welding process and a grip 9 intended to allow the operator to handle the torch 1 conveniently.
The ground cable 5 closes the circuit made up of generator, torch, element to be welded M and thus allows the welding operations to be started.
The welding unit furthermore comprises a control system 6 with first transmission/reception means 7. In the embodiment shown in the figure, the control system 6 is mounted between the connector 30 and the cable bundle 11. Alternatively, the control system 6 can be mounted in any other suitable position, for example in/on the grip of the torch 1.
The first transmission/reception means 7 preferably comprise a radiofrequency unit. Said radiofrequency unit is preferably of the Bluetooth® type. The first transmission/reception means 7 allow data and/or information to be transferred
from the main unit to the other components of the welding system and/or to any external device operating with Bluetooth® technology, for example a tablet or similar devices.

The power supply to the control system 6 is ensured by preferably rechargeable electrical accumulators. Said recharge can be obtained by using a battery charger that can be connected to the control system 6 or using the power supply cable 11b that feeds the torch 1 and/or external generators. The protection unit comprises a protective helmet 2 that the operator can wear during the welding operations. The protection unit furthermore comprises second transmission/reception means 12, not shown in the figure, and a protection screen 3, preferably an LCD filter.

The second transmission/reception means 12 preferably comprise a radiofrequency unit. Preferably, said radiofrequency unit is of the Bluetooth® type. The second transmission/reception means 12 allow data and/or information to be transferred from the protection unit to the other components of the welding system and/or to any external device operating with Bluetooth® technology, for example an iPad or similar devices.

The power supply to the devices included in the protection unit is obtained by means of rechargeable and/or replaceable electrical accumulators. The data collection/transmission unit C comprises the sensors 41, 42, 43, 15 and a data collection/transmission system 27. The data collection/transmission system 27 can advantageously be integrated in the control system 6 or can be mounted in the welding system, in the most convenient position.

Figures 2A and 2B schematically show a detail of the welding system shown in Figure 1.

More particularly, Figure 2A schematically shows a front view of the control system 6. The control system 6 is mounted between the connector 30 and the cable bundle 11. The control system 6 comprises a control panel 33 that in turn comprises an on/off button 32 suited to switch the control system 6 on/off, warning lights 34 that signal the status of the control system 6, push buttons 35 by means of which the operator can set some parameters related to the welding process.

The pipe 31 connects the control system to the cooling circuit of the torch 1, where provided.

Figure 2B shows a block diagram of the components of the control system 6.
When the operator holds the torch 1 and presses the button 8 to start the welding process, an electrical signal is transferred from the button 8 to the control system 6, by means of one or more control cables 11a. The microprocessor 13, included inside the control system 6, comprises an interface for connection with the button 8. The connection interface preferably comprises a low-pass filter 16. The low-pass filter 16 is preferably of the capacitive type. Preferably, there is one low-pass filter 16 for each one of the one or more control cables 11a of the cable bundle 11. The low-pass filter 16 makes it possible to filter the high frequency disturbances that otherwise would alter the signal received by the microprocessor 13. The disturbances get into the one or more control cables 11a of the cable bundle 11 by induction, due to the proximity of the one or more control cables 11a to the power supply cables 11b of the torch 1 that are also present in the cable bundle 11.

When the microprocessor 13 receives the signal intended to communicate that the button 8 has been pressed, it transmits the information to the protection unit, as better explained below, and then sends the signal to the generator 4. At this point the generator 4 can start to supply welding current through the cable bundle 11. The connection interface between the microprocessor 13 and the generator 4 preferably comprises a galvanic isolation element 14 for each one of the one or more control cables 11a. The galvanic isolation element 14 may comprise a relay, preferably in the solid state, or an optoisolator preferably comprising a photodiode/photocell pair. In this way, the potential of the generator 4 remains uncoupled from the potential of the microprocessor 13, making the latter unaffected by any fluctuations. The isolation obtained through an optoisolator is advantageous from the point of view of energy consumption.

The microprocessor 13 is furthermore connected to a current sensor 15 and to the first transmission/reception means 7. The current sensor 15 makes it possible to detect the presence of welding current supplied by the generator 4 in the cable bundle 11 and to measure its intensity. Its components are better described with reference to Figures 3A and 3B.

The microprocessor 13 thus receives information from the current sensor 15 when current starts flowing through the power supply cables 11b of the cable bundle 11. If the moment when the welding current starts flowing is known, the microprocessor 13 is capable of calculating the total interval of time during which the welding current flows through the cable bundle 11.
The first transmission/reception means 7 make it possible to communicate the
data received, processed and/or transmitted by the microprocessor 13 to the other
components of the welding system, in particular to the protection unit.
The first transmission/reception means 7 preferably comprise a radiofrequency
unit. Said radiofrequency unit is preferably of the Bluetooth® type. The first
transmission/reception means 7 thus preferably operate in wireless mode and
therefore make the structure of the entire welding system lighter.
If the first transmission/reception means 7 are on and/or are connected to other
transmission/reception means, this is properly signalled by the warning lights 34
on the control panel 33 of the control means 6.
Figure 3 schematically shows a 3D view (Figure 3A) and a sectional view
(Figure 3B) of a detail of the welding system shown in Figure 1.
More particularly, Figure 3 shows the components of the current sensor 15 of the
control system 6.
Figure 3A shows a 3D view of the current sensor 15, which is suited to detect the
presence of current flowing through the cable bundle 11 and in particular the one
or more power supply cables 11b and to measure its intensity.
The current sensor 15 preferably comprises a ferromagnetic circuit 19
cooperating with a Hall sensor 18.
The ferromagnetic circuit 19 comprises a C-shaped element arranged in such a
way as to at least partially envelope one or more power supply cables 11b of the
cable bundle 11. As an alternative, the ferromagnetic circuit 19 may comprise
two C-shaped elements arranged in such a way as to completely envelop one or
more power supply cables 11b of the cable bundle 11.
The Hall sensor 18 is positioned between two adjacent C-shaped elements.
The ferromagnetic circuit 19 is protected by a closing container 17.
The current sensor 15 furthermore communicates to the microprocessor 13 the
presence of current and its intensity, thus allowing the microprocessor 13 to
automatically recognize the operating mode of the generator 4: 2T or 4T mode.
This will be useful to determine the darkening mode of the protection screen 3
included in the protection unit, as explained here below with reference to Figure
4. In this way, the operator is not required to perform additional settings of the
system, since the operating mode is recognized automatically through the reading
of the welding current and based on the status of the torch button (8).
The use of a Hall effect current sensor 18 associated with a ferromagnetic circuit
constituted by two C-shaped cores positioned around the power supply cables 11b belonging to the cable bundle 11 makes it possible to achieve an optimal compromise between sensitivity to low currents and system compactness. In this way, the sensor occupies a minimal space and can be contained inside the control system 6. Furthermore, this solution offers greater sturdiness and higher immunity to the disturbances that may be coupled and high susceptibility to voltage spikes generated by quick-changing differences in potential. Figure 3B shows the sensor 15 along a cross section that is perpendicular to the cable bundle 11.

Figure 4 schematically shows a detail of the welding system shown in Figure 1. More particularly, Figure 4 shows a block diagram of the components included in the protection unit. The protection unit, as better described below, allows the operator to protect his/her eyes from the radiation produced by the welding arc.

The protection unit preferably comprises a protection helmet 2 (not shown in the figure but visible in Figure 1) that can be worn by the operator during the welding process. When the operator pushes the button 8 of the torch 1 to start the welding operations, the signal indicating that current is flowing through the one or more control cables 11a belonging to the cable bundle 11 reaches the first microprocessor 13. Using the first transmission/reception means 7 included in the control system 6 it is possible to transmit the signal indicating that the button 8 has been pressed - and that, therefore, the operator intends to start the welding operations - to the second transmission/reception means 12 included in the protection unit.

The second transmission/reception means 12 preferably comprise a radiofrequency unit. Preferably, said radiofrequency unit is of the Bluetooth® type. Therefore, the second transmission/reception means 12 preferably operate in a wireless mode and thus make the structure of the entire welding system lighter. Therefore, through the control system 23 of the protection screen 3, the second microprocessor 20 communicates to the protection screen 3 that the darkening phase can be started.

Once the screen 3 has been darkened, the information is transferred from the protection unit to the control system 6. At this point the microprocessor 13 informs the generator 4 that the button 8 has been pressed. Only at this point the
generator 4 will be informed of the position of the button 8 and will start supplying current for the welding process. Thus, the screen 3 will be dark before the supply of welding current by the generator 4 and therefore before the formation of the welding arc 10. In this way, the operator's eyes are never exposed to the radiation emitted by the welding arc 10.

The protection screen 3 preferably comprises an LCD filter. As is known to the expert in the art, an LCD filter is substantially constituted by several layers comprising polaroid films, glass and LCDs. An LCD filter filters and dims light at certain wavelengths and, changing the control voltage $V_c$ applied to it, it is possible to vary the degree of light filtering/dimming for the different wavelengths, in particular for the wavelengths in the visible spectrum. The degree of darkening (the term "darkening" means the filtration and/or attenuation of the radiation at a certain wavelength) of an LCD filter is measured in DIN degrees.

The desired DIN degree is supplied by the operator as an input, for example through the buttons 37 on the control panel 36 of the protection unit. Alternatively, the DIN degree can be set automatically by the microprocessor 20 that measures the light radiation emitted by the welding arc by means of the sensor 21 and converts it in the required DIN degree based on a table stored in the microprocessor 20 and/or in a memory unit, thus obtaining the control voltage $V_c$ of the LCD filter.

The value of the control voltage $V_c$ that the control system 23 calculates as an input for the protection screen 3 depends on the welding parameters and on some environmental parameters like, for example, the temperature of the protection unit. The temperature sensor 23, in fact, measures the temperature of the protection unit, in particular the temperature of the protection screen 3. In this way, the setting of the control voltage $V_c$ to be applied to the protection screen 3 to determine its correct darkening degree in DIN takes in consideration the actual temperature of the protection screen 3.

More particularly, for each DIN degree selected by the operator and communicated to the protection unit, the second microprocessor 20 has at its disposal a table in which each DIN degree corresponds to a set of possible values of the applicable control voltage $V_c$. Even more particularly, for each temperature interval within which the temperature of the LCD filter is included,
there is a corresponding specific control voltage Vc, for each DIN degree. Therefore, the second microprocessor 20, once having received the value of the temperature of the LCD filter from the temperature sensor 23, verifies the temperature range within which the filter temperature is included and then applies the corresponding control voltage Vc, based on the DIN degree selected by the operator.

The higher the temperature of the LCD filter, the lower the value of the control voltage Vc to be applied and, therefore, the higher the energy saving. Vice versa, the lower the temperature of the LCD filter, the higher the value of the control voltage Vc to be applied and, therefore, the higher the energy consumption.

When the operator wants to interrupt the welding operations, the information is transmitted to the protection unit through the transmission/reception means 7. The opening (that is, the reduction in the degree of filtration/attenuation of the radiation) of the protection screen 3, however, does not take place immediately, at the exact moment when the button is released, but with a certain delay with respect to this event. The delay with which the opening of the protection screen 3 takes place is calculated based on the welding time, that is, based on the time during which the current sensor 15 has measured the passage of current inside the cable bundle 11. In any case, the delay never exceeds a preset time, for example 1 sec.

In the case where communication with Bluetooth® technology between the first transmission/reception means 7 and the second transmission/reception means 12 should not work properly due to any technical problem, the darkening of the protection screen 3 is ensured, in any case, by a system of optical sensors 21 included in the protection unit. The optical sensors 21, in fact, independently of the communication system described above, detect the presence of the welding radiation and, through the reading system 22 of the optical sensor, communicate to the protection screen 3 that the darkening phase can be started.

The protection unit may comprise, furthermore, transducer means 24. The transducer means 24 comprise, for example, a display unit 26, a microphone 25 and/or an acoustic diffuser 29 intended to allow the operator to communicate with the main unit and/or the external environment, for example the company’s data network.

Using the display unit 26, the operator can read the data sent by the main unit and thus get to know the data relating to the welding and/or cutting process. Using
the microphone 25 and/or the acoustic diffuser 29, the operator can also communicate with the external environment in relation to both the welding and/or cutting data and any necessary service communication.

Figure 5 schematically shows a further detail of a welding and/or cutting system.

More particularly, Figure 5 schematically shows the data collection/transmission unit.

The data collection/transmission unit mainly comprises a data collection system 27 that in the preferred embodiment shown in the figures is included in the control system 6, as well as a set of sensors 41, 42, 43, 15.

The sensors 41, 42, 43, 15 are preferably included in the connection element 40 that comprises also the power supply cable 1 lb, the wire guide sheath with the welding wire, the water pipe of the cooling system and the gas pipe coming from the cylinder 28.

The sensors 41, 42, 43, 15, conveniently positioned in the welding system, supply the data collection system 27 with data concerning the wire speed, the flow rate of the gas emitted by the gas cylinder 28, the welding voltage and the flow rate and temperature of the liquid circulating in the torch cooling circuit, where provided.

The sensors communicate with the data collection/transmission system 27 via a wired or wireless connection.

The sensor 41 that measures the gas flow rate can be a differential pressure sensor and/or an absolute pressure sensor, in the case where the geometry of the gas pipe is known. Alternatively, a volumetric flow sensor can be used.

The sensor 43 that measures the liquid flow rate in the cooling circuit can be a differential pressure sensor and/or an absolute pressure sensor, in the case where the geometry of the water pipe is known. Alternatively, a volumetric flow sensor can be used.

The liquid temperature is measured by a temperature sensor of the ptc and ntc type that transduces the temperature into an electrical signal.

The data collection/transmission system 27 collects and/or reads and/or stores the welding data that are transmitted to it. The data collection/transmission system 27 may also comprise software for processing the received data.

The data collected by the data collection/transmission system 27 can be transmitted, via a wired or wireless connection, to the microprocessor included in the control system 6, to the protection unit and/or to the external environment.
environment, for example the company's data network. In this way, the operator can be instantaneously informed on the welding parameters that he/she is using, for example by displaying them on the display unit 26 or listening to them through the diffuser 29 located in the helmet 2, and the same data can also be communicated to the external environment. For example, the data can be transmitted to a printing unit in order to print the welding report. According to the embodiment illustrated herein, the data collection/transmission system 27 is positioned inside the control system 6, but it can alternatively be located in any other convenient part of the welding system.

If communication with the data collection/transmission system 27 takes place through Bluetooth® technology, the welding data can be easily received by any device suitable for this type of wireless communication, for example a PC, a tablet or similar devices.

Even though the present invention has been described with reference to the embodiments illustrated above, it is clear to the expert in the art that it is possible to carry out several changes, variants and improvements of the present invention in the light of the indications provided above and within the scope of the attached claims, without departing from the subject and scope of protection of the invention.

Finally, those fields that are considered as already known to the experts in the art have not been described herein, in order to avoid uselessly putting the illustrated invention in the shade.

Consequently, the invention is not limited to the embodiments described above, but it is limited only by the scope of protection defined by the attached claims.
CLAIMS

1. Sensor (15) for welding and/or cutting systems comprising a generator (4), a welding and/or cutting torch (1) and a connection element (40) comprising one or more power supply cables (1 lb) of said torch (1) and/or one or more control cables (11a) of said torch (1); said sensor (15) being characterized in that it is suited to detect the passage of current in at least one of said one or more cables of said connection element (40); and said sensor being characterized in that it comprises a ferromagnetic circuit (19) that at least partially envelopes said at least one of said one or more cables of said connection element (40) and a Hall sensor (18).

2. Sensor (15) according to claim 1, characterized in that it is suited to measure the intensity of said current that flows through said one or more power supply cables (1 lb).

3. Current sensor (15) according to any of the preceding claims, characterized in that said ferromagnetic circuit (19) comprises one or more C-shaped elements.

4. Current sensor (15) according to claim 3, characterized in that said one or more C-shaped elements at least partially envelop/envelops said one or more power supply cables (1 lb) of said torch (1) or parts of said torch body (1).

5. Current sensor (15) according to any of the preceding claims, characterized in that it comprises a closing container (17) in which said ferromagnetic circuit (19) is closed.

6. Current sensor (15) according to any of the preceding claims, characterized in that it is suited to be connected to a microprocessor (13) comprise in said welding system, in such a way as to signal to said first microprocessor (13) the passage of current in said one or more power supply cables (1 lb) of said torch (1).

7. Welding and/or cutting unit comprising a welding and/or cutting torch (1) and a connection element (40) comprising one or more power supply cables (1 lb) of said torch (1); said welding unit being characterized in that it comprises a current sensor (15) according to any of the claims from 1 to 6.

8. Welding and/or cutting unit according to claim 7, characterized in that it comprises a microprocessor (13) suited to automatically recognize the operating mode of said torch (1), for example 2T or 4T mode, based on the signal received from said current sensor (15) and on the position of the button.
9. Welding and/or cutting system comprising a generator (4), a welding and/or cutting torch (1), a connection element (40) comprising one or more power supply cables (1 lb) of said torch (1) and a protection unit; said welding system being characterized in that it comprises a current sensor according to any of the claims from 1 to 6 or in that it comprises a welding unit according to claim 7 or 8.

10. Welding system according to claim 9, characterized in that it comprises a microprocessor (13) suited to automatically recognize the operating mode of said torch (1), for example 2T or 4T mode, based on the signal received from said current sensor (15) and on the position of the button (8).

11. Welding and/or cutting system according to any of the claims from 9 to 12, characterized in that the darkening of a protection screen (3), for example an LCD filter, included in said protection unit, is a function of the current measured by said current sensor (15).
**INTERNATIONAL SEARCH REPORT**

**International application No**
PCT/IB2015/052409

**A. CLASSIFICATION OF SUBJECT MATTER**

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According to International Patent Classification (IPC) or to both national classification and IPC.

**B. FIELDS SEARCHED**

Minimum documentation searched (classification system followed by classification symbols):

- A61F
- B23K
- F16P
- G01R

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched.

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used):

- EPO-Internal

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

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Further documents are listed in the continuation of Box C. X See patent family annex.

* Special categories of cited documents:

- "X" document defining the general state of the art which is not considered to be of particular relevance.
- "E" earlier application or patent but published on or after the international filing date.
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- "O" document referring to an oral disclosure, use, exhibition or other means.
- "P" document published prior to the international filing date but later than the priority date claimed.
- "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention.
- "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone.
- "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.
- "A" document member of the same patent family.

Date of the actual completion of the international search:

9 June 2015

Date of mailing of the international search report:

17/06/2015

Name and mailing address of the ISA/

- European Patent Office, P.B. 5818 Patentlaan 2
- NL - 2280 HV Rijswijk
- Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016

Authorized officer:

- Cazacu, Corneliu
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