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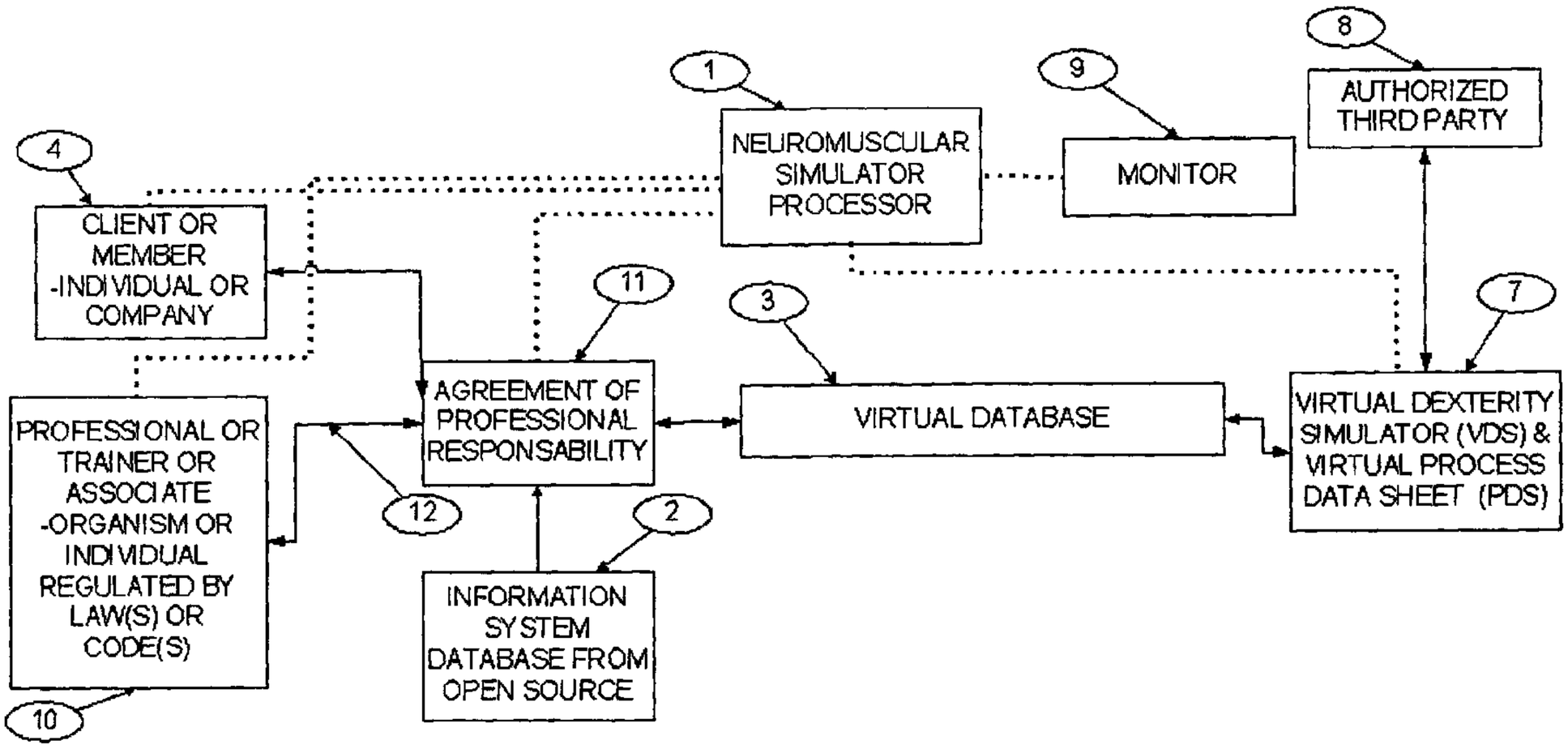
(54) Titre : SYSTEME ET PROCEDE DE SIMULATION VIRTUELLE POUR L'ENTRAINEMENT NEUROMUSCULAIRE ET DE DELIVRANCE D'UN CERTIFICAT VIA UN RESEAU DE COMMUNICATION

(54) Title: VIRTUAL SIMULATOR METHOD AND SYSTEM FOR NEUROMUSCULAR TRAINING AND CERTIFICATION VIA A COMMUNICATION NETWORK



(57) Abrégé/Abstract:
A virtual simulator method and system via a communication network with possible physics law respect is used to create a virtual skill training environment for dexterity fulfillment of physical activities such as professional work, labour or craft activities, sport or even physical rehabilitation requirements where the skills or neuromuscular ability is required to be performed in a precise environment. All information required insuring a code of conduct, state-of-the-art, physic laws, technical code and technique for physical activities training certification for a member are managed and maintained in a database by an online processor. This database is maintained for continuous neuromuscular training improvement updates. Access to a third party witness in this training program is allowed to ensure code, law and state-of-the-art integrity when certification is required.

Abstract

A virtual simulator method and system via a communication network with possible physics law respect is used to create a virtual skill training environment for dexterity fulfillment of physical activities such as professional work, labour or craft activities, sport or even physical rehabilitation requirements where the skills or neuromuscular ability is required to be performed in a precise environment. All information required insuring a code of conduct, state-of-the-art, physic laws, technical code and technique for physical activities training certification for a member are managed and maintained in a database by an online processor. This database is maintained for continuous neuromuscular training improvement updates. Access to a third party witness in this training program is allowed to ensure code, law and state-of-the-art integrity when certification is required.

Virtual simulator method and system for neuromuscular training and certification via a communication network

Field of the invention

The field of the invention is related to professional work, labour or craft activities, sport or even physical rehabilitation requirements where the skills, dexterity or neuromuscular ability is required to performed physical activities in a precise environment with electronic tutoring systems and methods, and more particularly, to an interactive computer-based training system and method operable over an Internet Protocol (IP)-based public computer network such as the Internet, a corporate Intranet, and the like. This precise environment can be located in a online database for code of conduct, state-of-the-art, physic laws or technical code for physical activities requiring training and certification.

Summary of the invention

By practicing online virtual certification over the Internet and the World Wide Web, it has become obvious that a technological gap exists between traditional certification and online certification. This gap is related to the fact that there is no available technology in the Internet Protocol (IP)-based public computer network such as the Internet, corporate Intranet or the like for the physical and cerebral training to accomplish a minimum dexterity required by code, rule of the art or any physical function requiring minimum requirements related to neuromuscular activities.

For example, an online 2D, 3D, near 3D visual multimedia signal and auditory signal can create an environment that could easily simulate visual inspection, non-destructive examination or destructive examination to ensure neuromuscular workmanship or craftsmanship requirements or skill training dexterity. Instead of learning by traditional manual approach, a simulator method develops all the minimum requirements needed in profession, industry, field, sport or rehabilitation activities.

The implementation of virtual simulator method and system are also intended to help the trainee to learn a technique and not to cope with difficult environment. For example, in a traditional welding training center, the welder trainee has first to compose with the difficult environment of the welding electric arc (eye protection and gaseous emanations and other complex technical considerations). Also in a typical approach, a trainee can easily spare a very considerable amount of money before handling very expensive material and technology.

According to the present invention, there is provided a virtual simulator system for neuromuscular training and certification via a communication network, comprising:

a database connectable to the communication network, the database storing data relative to a code of conduct, state-of-the-art, physics law equations, technical code and technique for physical activities requiring training and certification for a user, and training scenarios complying with the code of conduct, state-of-the-art, physics law equations, technical code and technique;

a multimedia device connectable to the communication network, the multimedia device having a stopwatch circuit and an input device for interaction with a user; and

an on-line simulator processor connectable to the communication network, the on-line simulator processor performing operations comprising:

retrieving data representative of one of the training scenarios from the database in response to a user selection on the multimedia device;

generating test elements, parameters and controls based on the data;

monitoring online use of the input device by the user;

performing calculations of a simulated environment on time and online in response to the use of the input device by the user and management of the test elements, parameters and controls by the user;

generating real time images on the multimedia device replicating the simulated environment according to the management of the test elements by the user as a function of run-time data provided by the stopwatch circuit; and

recording the test elements in the database.

According to the present invention, there is also provided a virtual simulator method for neuromuscular training and certification via a communication network, comprising the steps of:

storing data relative to a code of conduct, state-of-the-art, physics law equations, technical code and technique for physical activities requiring training and certification for a user, and training scenarios in a database connectable to the communication network;

providing a multimedia device connectable to the communication network, the multimedia device having a stopwatch circuit and an input device for interaction with a user; and

through an on-line simulator processor connectable to the communication network, performing operations comprising:

retrieving data representative of one of the training scenarios from the database in response to a user selection on the multimedia device;

generating test elements, parameters and controls based on the data;

monitoring online use of the input device by the user;

performing calculations of a simulated environment on time and online in response to the use of the input device by the user and management of the test elements, parameters and controls by the user;

generating real time images on the multimedia device replicating the simulated environment according to the management of the test elements by the user as a function of run-time data provided by the stopwatch circuit; and

recording the test elements in the database.

According to the present invention, there is also provided a multimedia device connectable to a virtual simulator system having an on-line simulator processor and a database for neuromuscular training and certification via a communication network, comprising:

a stopwatch circuit;

an input device;

a user interface;

a port for communication with the on-line simulator processor through the communication network; and

a processor connected to the stopwatch circuit, the input device, the user interface and the port, the processor comprising means for:

transmitting data produced by use of the input device on the user interface to the on-line simulator processor via the port;

receiving test elements, parameters and controls and simulated environment data from the on-line simulator processor via the port;

monitoring a management of the test elements, parameters and controls by the user as a function of run-time data provided by the stopwatch circuit; and

displaying real time images on the user interface replicating a simulated environment using the simulated environment data according to the management by the user.

According to the present invention, there is also provided an apparatus for neuromuscular training and certification on a multimedia device via a communication network, comprising

a database connectable to the communication network, the database storing data relative to a code of conduct, state-of-the-art, physics law equations, technical code and technique for physical activities requiring training and certification for a user, and training scenarios complying with the code of conduct, state-of-the-art, physics law equations, technical code and technique; and

an on-line simulator processor connectable to the communication network, the on-line simulator processor performing operations comprising:

retrieving data representative of one of the training scenarios from the database in response to a request received from the multimedia device representing a user selection;

generating test elements, parameters and controls based on the data;

communicating the test elements, parameters and controls to the multimedia device;

monitoring user activity data received from the multimedia device;

performing calculations of a simulated environment on time and online in response to the user activity data in relation with the test elements, parameters and controls;

transmitting simulation data to the multimedia device causing the multimedia device to generate real time images replicating the simulated environment according to the user activity data; and

recording the test elements in the database.

According to the present invention, there is also provided a computer readable memory having recorded thereon statements and instructions for execution by a computer system to carry out the above method.

According to the present invention, there is also provided a computer program product, comprising:

a memory having computer readable code embodied therein, for execution by an on-line simulator processor, for neuromuscular training and certification via a communication network, said code comprising:

code means for storing data relative to a code of conduct, state-of-the-art, physics law equations, technical code and technique for physical activities requiring training and certification for a user, and training scenarios in a database connected to the communication network; and

code means for retrieving data representative of one of the training scenarios from the database in response to a user selection on a multimedia device connected to the communication network;

code means for generating test elements, parameters and controls based on the data;

code means for monitoring online use of an input device on the multimedia device by the user;

code means for performing calculations of a simulated environment on time and online in response to the use of the input device by the user and management of the test elements, parameters and controls by the user;

code means for generating real time images on the multimedia device replicating the simulated environment according to the management of the test elements by the user as a function of run-time data provided by a stopwatch circuit of the multimedia device; and

code means for recording the test elements in the database.

According to the present invention, there is also provided a carrier wave embodying a computer data signal representing sequences of statements and instructions which, when executed by an on-line simulator processor, cause the on-line simulator processor to perform a virtual simulation for neuromuscular training and certification via a communication network, the statements and instructions comprising the steps of:

storing data relative to a code of conduct, state-of-the-art, physics law equations, technical code and technique for physical activities requiring training and certification for a user, and training scenarios in a database connected to the communication network; and

retrieving data representative of one of the training scenarios from the database in response to a user selection on a multimedia device connected to the communication network;

generating test elements, parameters and controls based on the data;

monitoring online use of an input device on the multimedia device by the user;

performing calculations of a simulated environment on time and online in response to the use of the input device by the user and management of the test elements, parameters and controls by the user;

generating real time images on the multimedia device replicating the simulated environment according to the management of the test elements by the user as a function of run-time data provided by a stopwatch circuit of the multimedia device; and

recording the test elements in the database.

According to the present invention, there is also provided a memory for storing data for access by an application program being executed on a data processing system, comprising:

a data structure stored in the memory, the data structure including information resident in a database used by the application program and including:

code of conduct data;

state-of-the-art data;

physics law equation data;

technical code and technique data for physical activities requiring training and certification for a user; and

training scenarios complying with the code of conduct, state-of-the-art, physics law equations, technical code and technique, to be used by the application program to generate test elements, parameters and controls for neuromuscular training and certification via a communication network.

The following provides a non-restrictive outline of certain features of the invention more fully described herein after.

The present invention relates to a virtual simulator method and system for neuromuscular training and certification of profession, trade, craft, sport or rehabilitation activities via a communication network and more particularly to an online multifunctional virtual training platform which implements certain predefined certification neuromuscular standards. Such method and system, which can be viewed as a service, are particularly useful for enhancing communication and exchanges between trainer and trainee seeking training with third party witnessing services for certification purposes.

Any physical activities that require a minimal dexterity requirement can benefit from this invention. For example it is common knowledge that neuromuscular skills (by opposition of neurocerebral skills) are essential for basic requirement of specialized physical activities for a professional work, labour or craft activities, sport or even physical rehabilitation.

Neuromuscular virtual online training or certification can be simulated, for example, for speed control, acceleration, strength, precision or any neuromuscular abilities related to a direct relation with physical action and neurological responses.

For example, skill ability for a profession, trade, craft or sport example could be welding. The welding ability to perform a sound weld according to code requirement is of a particular interest since it could involve safety, liability and life duration of assembled material. In the field of welding, many scientific relations between welding variables are known by experts but no relation between welder dexterity and state-of-the-art equations have been documented yet. This approach can minimize physical test cost. These costs could increase easily when the test material is technological (welding station, welding consumables and metal plates and specialist's time). One prototype of such a Web site is under confidential research and development in the online virtual certification site of WWW.EDUWELDING.COM, for the assignee of the present application. This site provides an example of one possible implementation of this invention. The site is used as an online training tool by school, association, certification bureau, consumable or equipment supplier, plant or shop. Such organisms can access updated information about the trainee member status and related information about all the steps involved in the training and certification of this welding process trainee. The member can disclose some of this information to a third party in the course of their technical or business relationship with that member. This Web site contains a welding virtual simulator method and system able to demonstrate to a trainer or a third party the ability of a trainee. This virtual simulator method and system are also able to help the trainer to isolate the specialized neuromuscular skills that the trainee has to practice to insure himself of good results when over a demonstration of his skills is required.

With the help of physic laws equation such as dynamic, mechanic of fluid and thermodynamic, the dexterity of the welder can be demonstrated by an online virtual simulator method and system to a trainer, immediate superior or certification representative for learning curve demonstration or for code minimum requirements. Prior to a physical test or to an online third party witnessing operation, a database configuration with the processor is performed to ensure sound weld, weld size, maximum root penetration with metal transfer mode used in conjunction will the welding parameter settings.

This virtual simulator method and system can enable any weld assembly and fulfills all criteria of a welder test such as defined by a welding code by simply activating a computer screen signal by the multimedia device. A good example of this online neuromuscular virtual simulator method and system applied in the field of welding is a traditional T joint assembly of a weld assembly (fig. 12) to insure efficient weld penetration and weld size achievement without other code defect such as porosity, cracks or undercut. Code compliance and trainee, trainer and/ or third party witnessing expert receives information from the virtual simulator method and system according to authorized request.

This above example of neuromuscular training for welder is described hereafter with the help of the drawings.

It also serves to structure steps and processes implemented by companies for quality, cost and delay controls and other purposes. This leads to more efficient dissemination of information about the qualifications and competencies of persons being certified with the present invention. It therefore leads to a wider recognition of trainees for companies and other organizations using the invention.

Preferably, the manual dexterity virtual simulator method and system with the third party witnessing method involve the use of a system as described in Can. Pat. No. 2,311,685 issued to Choquet. Such a manual training is advantageous in that it permits a controlled input of essential variables to required tasks with third party witnessing certification.

Background of the present invention

Training method or simulator devices are in the art. There is a wide list of methods and devices reproducing a physical activity where human skills are of main concerns. But they are all related to an hardware simulator. The term hardware simulator is commonly used in the trade because the vast majority of simulators require hardware tools associated software to accurately help a user to perform his/her physical activities and an object to complete the simulated task . Typical simulators of this type are shown, for example, in the following patents documents:

FR 2 827 066	Dasse Michel & Streib Dominique
US 6 477 665	Bowman-Amuah; Michel K.
US 6 371 765	Wall et al
US 6 222 523	Harvill Young L et Al
US 6 190 178	Oh Min Seok
US 6 104 379	Kramer James F et Al
US 6 098 458	French & Ferguson
US 6 056 556	Braun et al
US 6 035 274	Kramer James F et Al
US 6 033 226	Bullen et al
US 5 986 643	Harvill Young L et Al
US 5 727 950	Padwa David J et Al
US 5 320 538	Baum; David R.
US 4 931 018	Herbst et al
US 4 680 014	Paton et al
US 4 124 944	Blair; Bruce A.
CA 2 311 685	Choquet Claude
US 2001/023059	Toki Nozomi
ISBN : 0-7803-243-5	Gomez D et Al
ISBN : 0-201-94687-4	Zhai S et Al

Though such simulators have achieved considerable popularity and possibly commercial success, there has been a continuing need for improvement. Summary of the present invention does not need any particular hardware simulator to reproduce the

training environment. Its interest resides in the software control and management of neuromuscular data collected over image collection simulating environment where the skill or dexterity is of major concern to accomplish a minimum requirement by code, rule of the art or any physical function requiring minimum requirements related to neuromuscular activities.

Description of the preferred embodiments

Referring to Figure 1, training scenarios are retrieve from the information system database 2 and then processed by the neuromuscular simulator processor 1 to the required trainee level. The vitual database of skills activities 3 is maintain up to date thanks to the virtual reality dexterity (VDS) and the virtual process data sheet (PDS) 7. More details for the VDS are avalaible in figure 11 while more details of PDS are avalaible in figure 10 . This training scenario is related to Choquet (2311685), and is related to the fact that certification is possible if the third party witness 8 is auditing the activities between the member 4 and the expert 10 in this VDS third party loop with the related link 12 in order to get an agreement of professional responsibility 11. All activities are monitored and the monitor 9 required to perform such certification is avalaible through the complete process.

The data storage item 3 fig. 1 will be kept in virtual database 36 referring to figure 3. The member site 31 access by external link network via communication network 32 to a detailed open training database center site 36. The administrator/ controller 33 gives members access to a process report data base for audits steps 34, to an authentification database 35, to a main process database, to a notorization database, 38 and to a member information database 39.

A description will now be given, in detail, of an embodiment in accordance with the present invention. The present invention is not restricted to this embodiment.

Referring to figure 4, there is shown a welding scenario flowchart detailing a general training process followed by the system according to the present invention. After log in information 41, the member acess the retrieved welding scenario 43 is processed online to ensure code and trainee accurate revision status. When confirmed positive, the submitted welding request informations 42 from the customer are updated from existing welding scenarios. Welding training scenarios are multimedia information. An validation of conformity will then be processed via the main process database 45 to confirm welding configuration validity. Specific information about the input of welding training scenarios is shown in figure 10 and 11.

Looping step 44 is responsible to verify the welding configuration validation with code requirement and state-of-the-art physical activities. Welding configuration, code requirements are manage in this loop until scientific and code requirements are met.

Referring to figure 5, there is shown a sequence for updating a welding training scenario (figure 4 item 42). The virtual dexterity simulator (VDS) inputs 51 are processed with a code of conduct, physics law equations, technical code and technique from 37 to produce a test result according to welding variables (PDS or VDS) result 52. These tests results could then be notarized 54 to ensure proper consultation in the notorization databse 38. When this loop is positive, it is possible to add a third party seal of approval to insure that the information is conform to code regulations 55.

Referring to figure 6, there is shown an operation flow of the training/ certification method for the welding scenario, an operation flow of accepting or registering a new member site and a layout example of the authentification database 35. In this welding certification example, to ensure access to his personnalized information 61, the member have access to his own data 64 and a third party 63 is also able to audit the information when required in this loop.

Referring to figure 7, there is shown an operation flow of training/ certification steps and interface display for the welding scenario. Once identification fig. 6 is completed, the member have access to his welder's current certification, its update, the proof of that update and its tracking 71. An update of his competency card 72 can be obtained and addressed 73 to the proper Authority or any party responsible for an action. A report for third party 74 is also avalaible. This report will always be monitored 75 for proper actions.

Referring to figure 8, there is shown an example of a welding card holder. The welder's name 81 and the emission date 82 are related to a qualification assessment that a third party 84 or 85 are auditing for a list of essential variables 83 required to identify the welder's ability to perform his workmanship.

Referring to figure 9, there is shown an example of online welding certification checklist tracability of welder test scheduling of qualification of the welder/ welding operation,

machine welders and welding operator qualification test planning sheet item 91. The responsible are shown on item 92 and the retracability of their acknowledgement 93 is avalaible online on time. The legend gives the possible level of Authorized Individuals an example of specialist in the field of welding are as shown. Per example a Welder 94 can participate in a self evaluation of some steps that an authorized worker 96 would be able to approve prior to the welding engineer 95. If required an independant laboratory 97 could also be part of this Certification.

Figure 10 to 20 show the virtual simulator method and system method interface according to a preferred embodiment related to welding training. The system has client stations connected to a server station. Referring to figure 2, each work station may comprise a computer, a monitor and one or many input devices. These input devices will allows the trainee to increase realism of his operation by capturing displacement and orientation information. Examples of such motion capture input device known are conventional mouse, 3D mouse, touch screen, keyboard, electronic pencil or even bend and twist sensitive input strip. These input devices are examples but this invention is not limited to those. The client station may be used for different purposes, according to the access rights allocated to the user. For example, a trainee will have rights for performing various tests but will of course have no rights to change some data like his/her test results, his/her skill level. Such rights will possibly be granted to the trainer. Other rights will be granted to the certifying third party.

Welding data sheets such as figure 10 help welding trainee to set-up their work environment to perform optimize weld results. For example this welding data sheet will be used to configure the online virtual simulator system (figure 11).

Referring to figure 11, the simulator has an interface for interaction with the trainee. The interface can be conveniently provided by the monitor of the computer used by the trainee.

Referring to figure 10, a Process Data Sheet (PDS) is shown as an example of weld transverse cut 102. These cuts vary according to the weld preparation. A double U groove weld preparation 101 is shown. A list of welding essential variables are shown 103 and 104. Different shapes can be simulated by this Process Data Sheet (PDS). A

list of simulation shapes possibilities can be identified in reference named "ANSI/AWS D2.4, Standard Symbols for Welding, Brazing, and Non-destructive Examination". This PDS is an equivalent of a frame taken out from a animation movie such as a multimedia video. In other words, this PDS image is an animation picture extract shot representation of a weld transversal cut with the list of essentials variables that defined it.

Referring again to figure 11, the interface has a first window section in which the elements 105 to 128 used in the test are displayed. Another window section displays test parameters and controls 129 to 134 for interactively adjusting them if necessary. The simulator generates these elements based on preset data retrieved from 36 (shown in figure 3) item 36 database. The neuromuscular processor simulator does the required calculation on time and online in response to the starting procedure set in motion by the trainee with an input device (e.g. a mouse) and produces an image e.g. elements 135 to 138 that replicates a weld bead according to the welding parameter management by the trainee.

For example, two part of metal 135 and 136 are assembled in a proper position and essentials variables 105 to 134 are set in a proper manner to produce sound welds according to code criteria. When these essential variables are used in conjunction with a multimedia device that will allow a computer screen to receive signal 137 a virtual image of a weld 138 is obtained. This image can be processed to certify code and rule-of-the-art compliance. An unlimited application possibility of this method can be developed for any neuromuscular activities.

The objective of the trainee is to obtain a sound weld with a good management of his welding parameters. Sound weld are defined in welding code or handbook. An example of a good weld can be visualized in macrographic cut as shown in figure 12. This result can only be viewed after destructive test and cannot be monitored during welding with conventional welding technology.

Referring to figure 13, there is shown that the essential variables of the simulator system are adequately configured with the motion capture input device cursor help

that is set in motion by the motion capture input device such as a computer mouse. For example, figure 13 illustrates a simulation of the figure 12. This case is the welding set-up of 2 6"X6"X 3/8" alloy 6061-T6 aluminum plates aluminum with 0.045" diameter filler aluminum alloy 4043 in the horizontal position. The generally recognized dimensional code requirement size of the weld is 6mm (1/4") minimum with a convexity of 3 mm (1/8") maximum and a minimal penetration of 2 mm (1/16"). Therefore with the motion capture input device cursor , the trainee adjusts the current source to a wire speed adjustment, just like in real situation. In the illustrated example, the current source is activated for 250 amps.

The trainee test acceptance criteria will be in accordance with the generally recognized code requirements.

When the trainee considers that the test set-up is adequate, he/ she must affix the mouse cursor at the starting point of the assembly as shown in figure 14 for the tool positioning process. As soon as the trainee clicks on the motion capture input device, in this case a computer mouse, the neuromuscular simulator processor is started and activates a time calculation required for result output. In this patent application, this operation is visually shown by the build-up of an virtual hot-spot 141 (fig. 14). The trainee then must move the hot-spot created by the mouse cursor on the plates to join contact axis to demonstrate a sound weld. This kinematic translation operation from a start to a stop with the mouse cursor leave a virtual metal deposition 151 (fig. 15) similar as in a real time welding operation. Kinematic law equations such as displacement, speed and acceleration are of the important criteria but the straightness of the cursor motion is also. This precision is in the millimeter range.

As soon as the trainee clicks on the motion capture input device, in this case on the computer mouse, an instruction is given to the neuromuscular simulator processor to calculate a material deposition rate which coincides with an image simulating the real aluminum weld deposition. For example, this processor calculates the liquid state aluminum flow rate as long as the welder trainee will not have release the input device trigger which in this particular case is the computer mouse. If the trainee operates in a variable bracket combination which allows him/ her to deliver a welded zone according

to the training requirements, then the result will be a sound weld and considered without defect. If he does not operate according to the ideal training requirements or according to the rules of the art or the codes foreseen for that purpose, this deposited metal mass in the operating zone will have the consequence to create defects which will be visible as shown in Figure 15.

Referring to figure 15, there is shown a start-and-stop half-distance which is known in the field of welding as the compulsory stop-departure in the middle of the weld of an assembly test. This stop-and-start zone is always a potential zone of defects and the restart has to be in accordance with the code currently recognized in the field. The trainee handles the motion capture input device cursor quite like he would handle a welding gun trigger. The trainee has to maintain a constant speed and aim to maintain the straightness of the path to deliver a sound weld. His/ her 2nd start on the stop will be also visually inspected. It's because the demonstration of a stop-and-stop is also a factor of success or failure during a welder test.

Referring to figure 16, there is shown that during the welding when the speed is too big or small or when the cursor is not well positioned, error messages appear "Incorrect deposition" or "insufficient penetration ". These error messages are examples of the possible monitoring with the neuromuscular simulator. Others on-time process monitoring during welding are possible such as "Undercut", "Porosity" or "Cold lap".

Referring to figure 17, when the weld is completed the neuromuscular simulator processor stops the stopwatch and allows then to compare the speed with the real case which is required according to the data banks which are available to this neuromuscular simulator processor. A trainee auto-evaluation is always possible and if he/ she requires it, a virtual non-destructive or destructive visual exam is then possible by the trainer or any other online third party required to ensure welding code requirement compliance.

The trainee can then repeat as often as he/ she wishes it or as often as he/ she is allowed in the training environment by pushing button 172 (fig. 17) for a complete visual inspection. Non-destructive examination or destructive examination result of a neuromuscular test is also avalaible by clicking button 171. Referring to figure 18, the various results obtained allow the trainer and the third party witness or the certification

representative to observe a detailed quality and defects retracability report obtained according to build-up of his training program. Referring to figure 20, by experimenting several times the welding parameters, the trainee builds-up a learning curve. The trainee can re-experiment the weld deposition as often as he/ she wants and a learning curve file built-up as much as he/ she builds-up results.

The trainee will also see the visual test results or defects not usually available as soon as the weld is completed. For example, the trainee will see the weld bead with root lack of penetration, insufficient weld side or weld bead convexity not according to code.

A learning curve is also available to the trainee, for the trainer or for the third party witnessing auditor if required. All or only the decision-making person will decide if the trainee is then capable to switch to the stage of the practical tests with real welding equipments and consumables.

Referring to figure 19, the produced mathematical curves allow to generate a big number of images or numeric signals which shall be use to improve the training program and generate also more complex functions such as the examples described below.

- Visual exams (according to acceptance criteria code)
- Non-destructive exams: (ultrasonic, X-rays, magnetic particle and liquid penetrant)
- Destructive exams: (bending, tension, fracture, macrography)
- The complete path generated could be saved and be used on a welding programmable machine for a possible repetitive use
- Ontime and online welding robot guidance with remotely located expert using existing vision system

Brief description of the drawings

The objects and features of the present invention will become more apparent in conjunction with the accompanying drawings:

Figure 1 is a block diagram showing a simulator system according to the present invention.

Figure 2 is a schematic diagram illustrating a training station.

Figure 3 is a schematic diagram illustrating a system according to the present invention.

Figure 4 is a flowchart showing a general process followed by the system according to the present invention.

Figure 5 is a flowchart showing a database consulting process followed by the system according to the present invention.

Figure 6 is a flowchart showing an operation flow of different user interactions in the system according to the present invention.

Figure 7 is a flowchart showing an operation flow of certification steps & interface display in the system according to the present invention.

Figure 8 is a diagram showing an example of a card holder used in the system according to the present invention.

Figure 9 is a diagram showing an example of an online certification checklist used in the system according to the present invention.

Figure 10 is a diagram showing an example of a list of essential variables for certification use in the system according to the present invention.

Fig. 11 is a multimedia shooting view of a Virtual Dexterity Simulator (VDS).

Fig. 12 is a view illustrating a macrographic cut of a real welding assembly.

Fig. 13 – 17 are schematic diagrams showing the simulation process at different stages according to the present invention.

Fig. 18 is a schematic diagram illustrating loop result of non-satisfactory neuromuscular tests.

Fig. 19 shows an example of mathematical results of a neuromuscular test according to the present invention.

Fig. 20 shows an example of learning curves produced with the system according to the present invention.

1. A virtual simulator system for neuromuscular training and certification via a communication network, comprising:

a database connectable to the communication network, the database storing data relative to one or more of (A) a code of conduct, (B) state-of-the-art, (C) physics law equations, (D) technical code and technique for physical activities requiring training and certification for a user, or (E) training scenarios complying with the code of conduct, state-of-the-art, physics law equations, technical code and technique;

a multimedia device connectable to the communication network, the multimedia device having a stopwatch circuit and an input device for interaction with a user; and

an on-line simulator processor connectable to the communication network, the online simulator processor capable of performing operations comprising:

retrieving data representative of one of the training scenarios from the database in response to a user selection on the multimedia device;

generating test elements, parameters and controls based on the retrieved data;

monitoring online use of the input device by the user;

performing calculations of a simulated environment in real time and online in response to the use of the input device by the user and management of the test elements, parameters and controls by the user;

generating real time images on the multimedia device replicating the simulated environment according to the management of the test elements by the user as a function of run-time data provided by the stopwatch circuit;

recording the test elements in the database; and

certifying with a third party witnessing from a certification bureau that the online use of the input device by the user meets minimum requirements to satisfy a welding code.

2. The virtual simulator system according to claim 1, wherein the operations performed by the on-line simulator processor further comprise:

producing warning signals on the multimedia device depending on actions performed by the user with respect to a variable bracket of successful results determined using the data stored in the database.

3. The virtual simulator system according to claim 1, wherein the operations performed by the on-line simulator processor further comprise:

recording the real time images in the database; and

processing the real time images to certify code and rule-of-the-art compliance.

4. The virtual simulator system according to claim 3, wherein the operations performed by the on-line simulator processor further comprise:

analyzing the real time images and the test elements to produce test result data;

comparing the test result data with model result data stored in the database and producing consequent markings of the test result data; and

recording the markings in the database.

5. The virtual simulator system according to claim 4, wherein the operations performed by the on-line simulator processor further comprise:

building a learning curve according to the markings; and

storing the learning curve in the database.

6. The virtual simulator system according to claim 1, wherein the operations performed by the on-line simulator processor further comprise:

compiling the real time images and the test elements of successive tests performed by the user into the database in a form of playbacks selectively playable on the multimedia device in response to a user request.

7. The virtual simulator system according to claim 1, wherein the database comprises:

information system database unit comprising the data relative to a code of conduct, state-of-the-art, physics law equations, technical code and technique for physical activities requiring training and certification for a user, or training scenarios being stored in the information system database unit; and

a virtual database unit comprising the test elements.

8. The virtual simulator system according to claim 1, wherein the multimedia device comprises a user interface displaying the real time images.

9. The virtual simulator system according to claim 8, wherein the user interface comprises a process data sheet showing an illustration of an object subjected to a test, instructions for performing the test, and the test elements and parameters.

10. The virtual simulator system according to claim 9, wherein the process data sheet provides test controls for setting up the simulated environment and configuring test parameters.

11. The virtual simulator system according to claim 9, wherein the illustration of the object is taken out from an animation movie stored in the database.

12. The virtual simulator system according to claim 8, wherein the operations adapted to be performed by the on-line simulator processor further comprise:

processing the real time images for destructive and non-destructive examination of the test elements on the multimedia device in response to a user request.

13. The virtual simulator system according to claim 4, wherein the test elements comprise speed and spatial data.

14. The virtual simulator system according to claim 1, wherein the physic law equations fall under mechanical, kinematic, dynamic or thermodynamic laws related to neuromuscular functions.

15. The virtual simulator system according to claim 1, wherein the input device comprises a motion capture input device.

16. The virtual simulator system according to claim 16, wherein the management comprises a translation movement of the test elements in response to a motion of a mouse cursor.

17. The virtual simulator system according to claim 1, wherein the real time images show a progression of the test elements from substantially all angles.

18. The virtual simulator system according to claim 1, wherein the test elements, parameters and controls are all user configurable variables.

19. The virtual simulator system according to claim 1, wherein the operations adapted to be performed by the on-line simulator processor further comprise:

classifying the management as the physical activities in the database.

20. The virtual simulator system according to claim 1, wherein the operations adapted to be performed by the on-line simulator processor further comprise:

managing said one of the training scenarios by inputting test parameters for said one of the training scenarios, checking the test parameters until conformity with the technical code to produce a valid training scenario, and updating said one of the training scenarios with the valid training scenario.

21. The virtual simulator system according to claim 1, wherein the operations adapted to be performed by the on-line simulator processor further comprise:

selectively providing access to the test elements stored in the database as a function of the user.

22. A virtual simulator method for neuromuscular training and certification via a communication network, comprising the steps of:

storing data relative to at least one of (A) a code of conduct, (B) state-of-the-art, (C) physics law equations,(D) technical code and technique for physical activities requiring training and certification for a user, or (E) training scenarios in a database connectable to the communication network;

providing a multimedia device connectable to the communication network, the multimedia device having a stopwatch circuit and an input device for interaction with a user; and

through an on-line simulator processor connectable to the communication network, performing operations comprising:

retrieving data representative of one of the training scenarios from the database in response to a user selection on the multimedia device;

generating test elements, parameters and controls based on the retrieved data;

monitoring online use of the input device by the user;

performing calculations of a simulated environment in real time and online in response to the use of the input device by the user and management of the test elements, parameters and controls by the user;

generating real time images on the multimedia device replicating the simulated environment according to the management of the test elements by the user as a function of run-time data provided by the stopwatch circuit;

recording the test elements in the database; and

certifying with a third party witnessing from a certification bureau that online use of the input device by the user meets minimum requirements to satisfy a welding code.

23. The virtual simulator method according to claim 23, wherein the operations further comprise:

managing said one of the training scenarios by inputting the test parameters for said one of the training scenarios, checking the test parameters until conformity with the technical code to produce a valid training scenario, and updating said one of the training scenarios with the valid training scenario.

24. The virtual simulator method according to claim 23, wherein the operations further comprise:

configuring the database with the on-line simulator processor as a function of the test parameters.

25. The virtual simulator method according to claim 23, wherein the operations further comprise:

producing warning signals on the multimedia device depending on actions performed by the user with respect to a variable bracket of successful results determined using the data stored in the database.

26. The virtual simulator method according to claim 23, wherein the operations further comprise:

recording the real time images in the database; and

processing the real time images to certify code and rule-of-the-art compliance.

27. The virtual simulator method according to claim 27, wherein the operations further comprise:

analyzing the real time images and the test elements to produce test result data;

comparing the test result data with model result data stored in the database and producing consequent markings of the test result data; and

recording the markings in the database.

28. The virtual simulator method according to claim 28, wherein the operations further comprise:

building a learning curve according to the markings; and

storing the learning curve in the database.

29. The virtual simulator method according to claim 23, wherein the operations further comprise:

compiling the real time images and the test elements of successive tests performed by the user into the database in a form of playbacks selectively playable on the multimedia device in response to a user request.

30. The virtual simulator method according to claim 23, further comprising the step of displaying the real time images generated by the on-line simulator processor on a user interface of the multimedia device.

31. The virtual simulator method according to claim 23, further comprising the steps of displaying a process data sheet on a user interface of the multimedia device, the process data sheet showing an illustration of an object subjected to a test, instructions for performing the test, and the test elements and test parameters.

32. The virtual simulator method according to claim 33, wherein the process data sheet provides test controls for setting up the simulated environment and configuring the test parameters.

33. The virtual simulator method according to claim 33, wherein the illustration of the object is taken out from an animation movie stored in the database.

34. The virtual simulator method according to claim 23, wherein the operations further comprise:

processing the real time images for destructive and non-destructive examination of the test elements on the multimedia device in response to a user request.

35. The virtual simulator method according to claim 23, wherein the test elements comprise speed and spatial data.

36. The virtual simulator method according to claim 23, further comprising the step of establishing the physic law equations as a function of mechanical, kinematic, dynamic aid thermodynamic laws related to neuromuscular functions.

37. The virtual simulator method according to claim 23, wherein the input device comprises a motion capture input device.

38. The virtual simulator method according to claim 40, wherein the management comprises a translation movement of the test elements in response to a motion of a mouse cursor.

39. The virtual simulator method according to claim 23, wherein the real time images show a progression of the test elements from all angles.

40. The virtual simulator method according to claim 23, wherein the test elements, parameters and controls are all user configurable variables.

41. The virtual simulator method according to claim 23, wherein the operations further comprise:

classifying the management as the physical activities in the database.

42. The virtual simulator method according to claim 23, wherein the operations further comprise:

managing said one of the training scenarios by inputting test parameters for said one of the training scenarios, checking the test parameters until conformity with the technical code to produce a valid training scenario, and updating said one of the training scenarios with the valid training scenario.

43. The virtual simulator method according to claim 23, wherein the operations further comprise:

selectively providing access to the test elements stored in the database as a function of the user.

44. A multimedia device connectable to a virtual simulator system having an on-line simulator processor and a database for neuromuscular training and certification via a communication network, comprising:

a stopwatch circuit;

an input device;

a user interface;

a port for communication with the on-line simulator processor through the communication network; and

a processor connected to the stopwatch circuit, the input device, the user interface and the port, the processor comprising units for:

transmitting data produced by use of the input device on the user interface to the on-line simulator processor via the port;

receiving test elements, parameters and controls and simulated environment data from the on-line simulator processor via the port;

monitoring a management of the test elements, parameters and controls by the user as a function of run-time data provided by the stopwatch circuit;

displaying real time images on the user interface replicating a simulated environment using the simulated environment data; and

certifying with a third party witnessing from a certification bureau that the management of the test elements, parameters and controls by the user meets minimum requirements to satisfy a welding code.

45. An apparatus for neuromuscular training and certification on a multimedia device via a communication network, comprising:

a stopwatch circuit;

a database connectable to the communication network, the database storing data relative to a code of conduct, state-of-the-art, physics law equations, technical code and technique for physical activities requiring training and certification for a user, or training scenarios complying with the code of conduct, state-of-the-art, physics law equations, technical code and technique; and

an on-line simulator processor connectable to the communication network, the on-line simulator processor capable of performing operations comprising:

retrieving data representative of one of the training scenarios from the database in response to a request received from the multimedia device representing a user selection;

generating test elements, parameters and controls based on the retrieved data;

communicating the test elements, parameters and controls to the multimedia device;

monitoring user activity data received from the multimedia device;

performing calculations of a simulated environment in real time and online in response to the user activity data in relation with the test elements, parameters and controls;

transmitting simulation data to the multimedia device causing the multimedia device to generate real time images replicating the simulated environment according to the user activity data;

recording the test elements in the database; and

certifying with a third party witnessing from a certification bureau that user activity data by a user meets minimum requirements to satisfy a welding code.

46. A non-transitory computer readable medium having recorded thereon statements and instructions for execution by a computer system to carry out the method of claim 23.

47. A computer, comprising:

an on-line simulator processor for neuromuscular training and certification via a communication network;

a memory coupled to the on-line simulator processor and having stored thereon processor-executable instructions configured to cause the on-line simulator processor to perform operations comprising:

storing data relative to a code of conduct, state-of-the-art, physics law equations, technical code and technique for physical activities requiring training and certification for a user, and training scenarios in a database connected to the communication network; and

retrieving data representative of one of the training scenarios from the database in response to a user selection on a multimedia device connected to the communication network;

generating test elements, parameters and controls based on the retrieved data; monitoring online use of an input device on the multimedia device by the user;

performing calculations of a simulated environment in real time and online in response to the use of the input device by the user and management of the test elements, parameters and controls by the user;

generating real time images on the multimedia device replicating the simulated environment according to the management of the test elements by the user as a function of run-time data provided by a stopwatch circuit of the multimedia device; recording the test elements in the database; and

certifying with a third party witnessing from a certification bureau that the online use of the input device by the user meets minimum requirements to satisfy a welding code.

48. A non-transitory computer readable medium for storing data for access by an application program being executed on a data processing system, comprising:

a data structure stored in the memory, the data structure including information resident in a database used by the application program and including:

code of conduct data;

state-of-the-art data;

physics law equation data;

technical code and technique data for physical activities requiring training and certification for a user;

training scenarios complying with the code of conduct, state-of-the-art, physics law equations, technical code and technique, used by the application program to

generate test elements, parameters and controls for neuromuscular training or certification via a communication network; and

computer executable instructions for certifying with a third party witnessing from a certification bureau that online use of by a user meets the minimum requirements to satisfy a welding code.

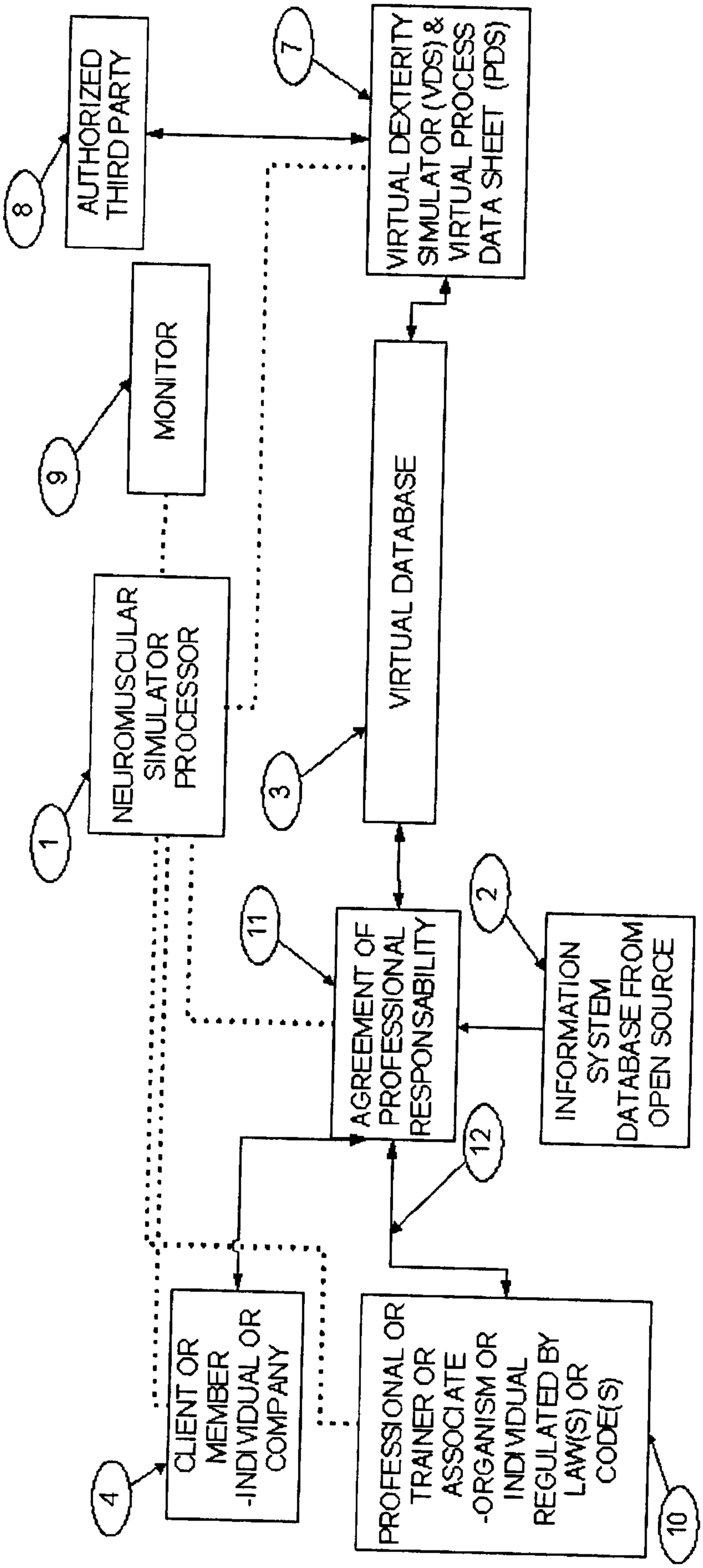

AUTHORIZED THIRD PARTY
8
7
VIRTUAL DEXTERITY SIMULATOR (VDS) & VIRTUAL PROCESS DATA SHEET (PDS)
MONITOR
9
NEUROMUSCULAR SIMULATOR PROCESSOR
1
3
VIRTUAL DATABASE
11
AGREEMENT OF PROFESSIONAL RESPONSABILITY
2
INFORMATION SYSTEM DATABASE FROM OPEN SOURCE
12
CLIENT OR MEMBER -INDIVIDUAL OR COMPANY
4
PROFESSIONAL OR TRAINER OR ASSOCIATE -ORGANISM OR INDIVIDUAL REGULATED BY LAW(S) OR CODE(S)
10

FIG. 1

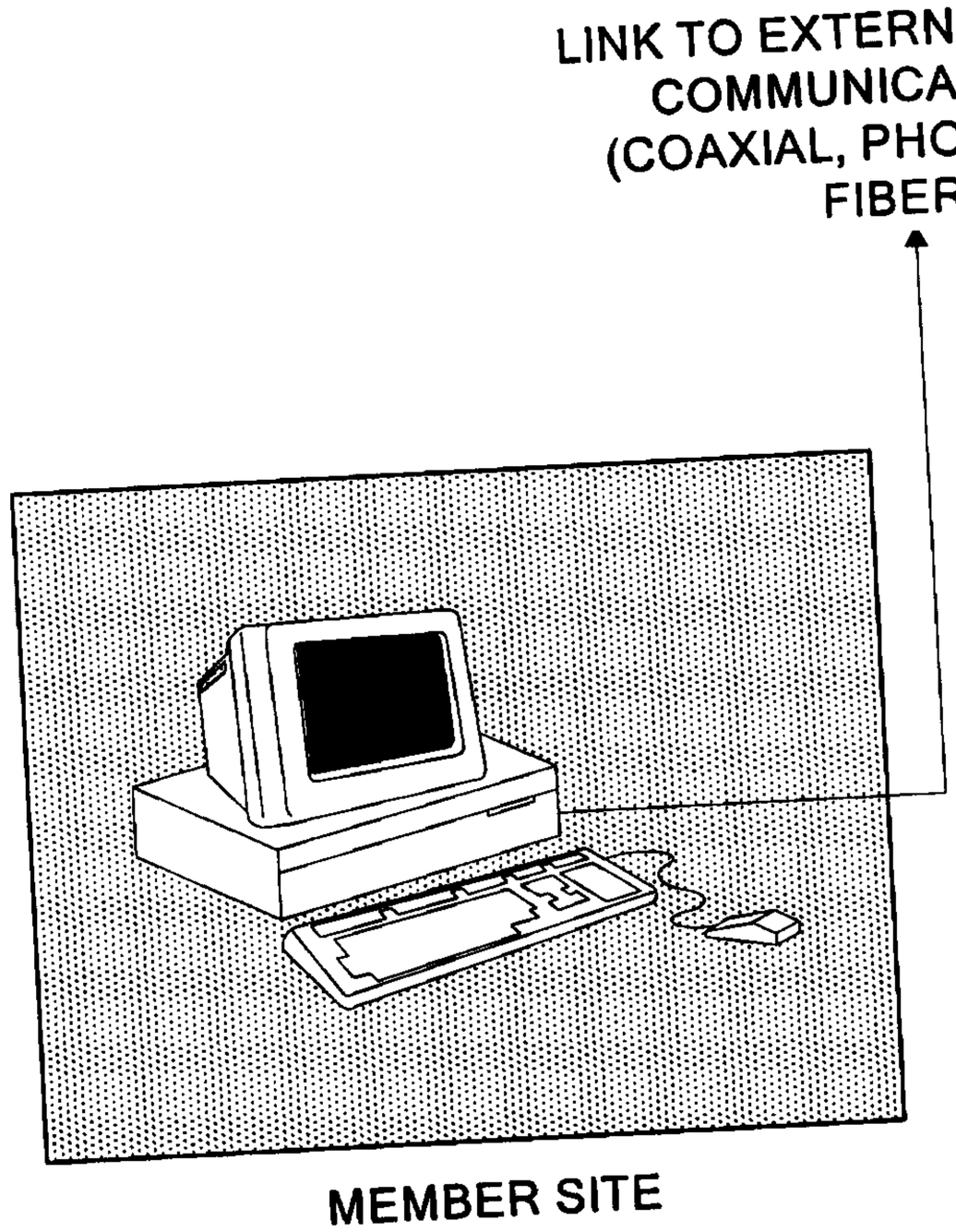

LINK TO EXTERNAL NETWORK VIA COMMUNICATION CABLES (COAXIAL, PHONE LINE, OPTIC FIBER, ECT.)
MEMBER SITE

FIG. 2

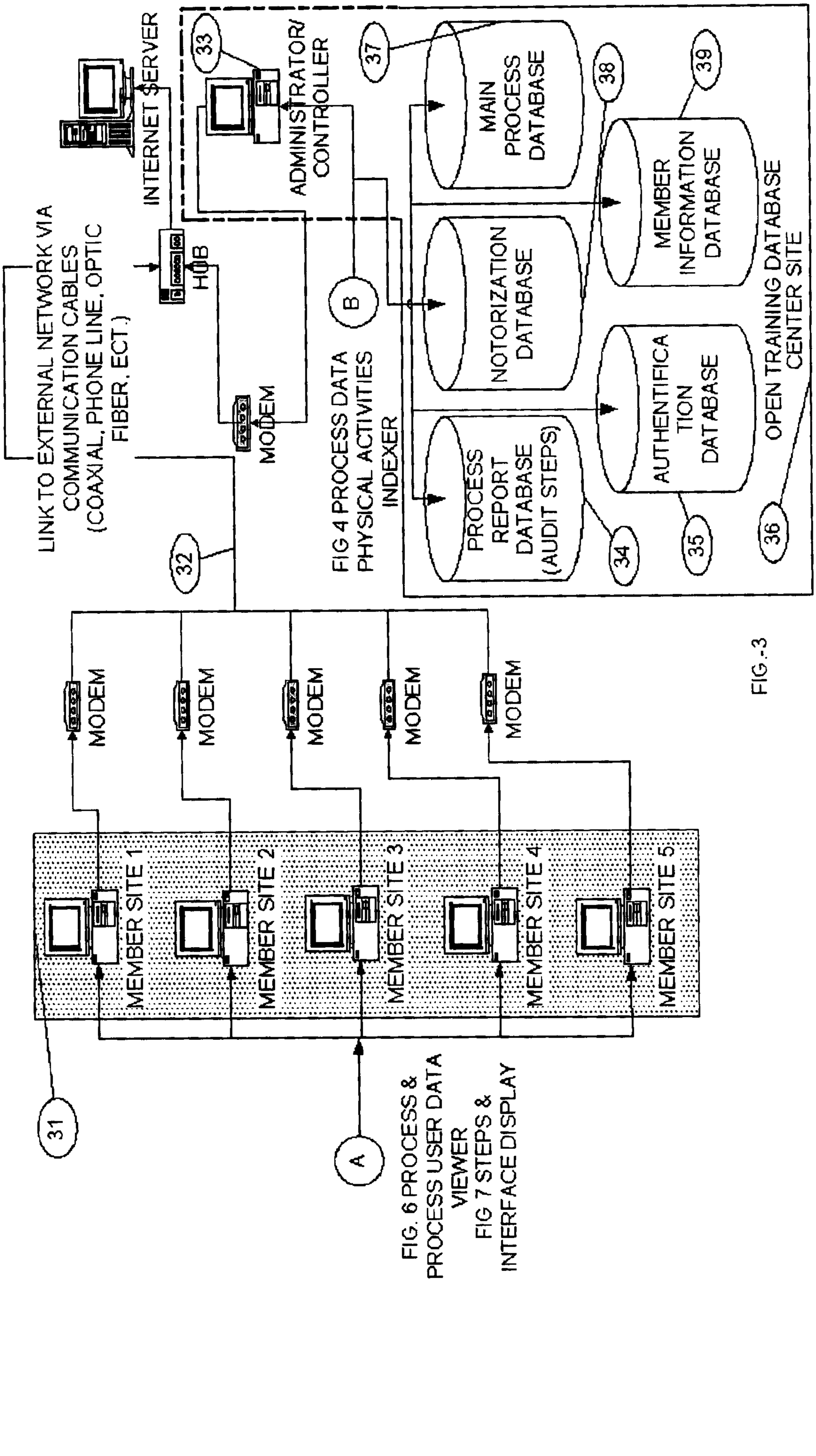

INTERNET SERVER
33
ADMINISTRATOR/
CONTROLLER
37
MAIN
PROCESS
DATABASE
38
39
MEMBER
INFORMATION
DATABASE
NOTORIZATION
DATABASE
AUTHENTIFICA
TION
DATABASE
PROCESS
REPORT
DATABASE
(AUDIT STEPS)
34
35
OPEN TRAINING DATABASE
CENTER SITE
36
B
HUB
MODEM
LINK TO EXTERNAL NETWORK VIA
COMMUNICATION CABLES
(COAXIAL, PHONE LINE, OPTIC
FIBER, ECT.)
FIG 4 PROCESS DATA
PHYSICAL ACTIVITIES
INDEXER
32
MODEM
MODEM
MODEM
MODEM
MODEM
MEMBER SITE 1
MEMBER SITE 2
MEMBER SITE 3
MEMBER SITE 4
MEMBER SITE 5
31
A
FIG. 6 PROCESS &
PROCESS USER DATA
VIEWER
FIG 7 STEPS &
INTERFACE DISPLAY

FIG.-3

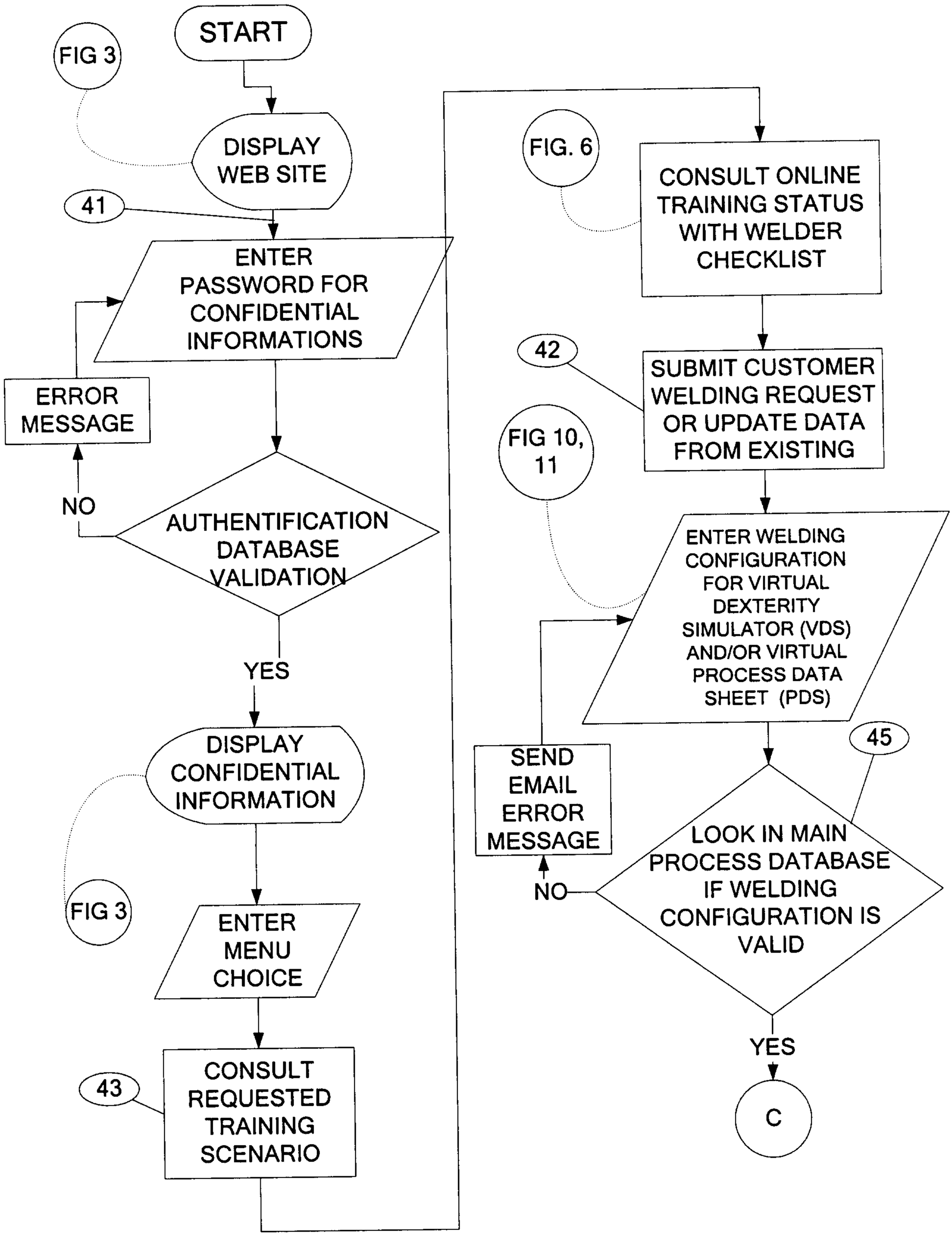

START
FIG 3
DISPLAY WEB SITE
41
ENTER PASSWORD FOR CONFIDENTIAL INFORMATIONS
ERROR MESSAGE
NO
AUTHENTIFICATION DATABASE VALIDATION
YES
DISPLAY CONFIDENTIAL INFORMATION
FIG 3
ENTER MENU CHOICE
43
CONSULT REQUESTED TRAINING SCENARIO
FIG. 6
CONSULT ONLINE TRAINING STATUS WITH WELDER CHECKLIST
42
FIG 10, 11
SUBMIT CUSTOMER WELDING REQUEST OR UPDATE DATA FROM EXISTING
ENTER WELDING CONFIGURATION FOR VIRTUAL DEXTERITY SIMULATOR (VDS) AND/OR VIRTUAL PROCESS DATA SHEET (PDS)
45
SEND EMAIL ERROR MESSAGE
NO
LOOK IN MAIN PROCESS DATABASE IF WELDING CONFIGURATION IS VALID
YES
C

FIG. 4

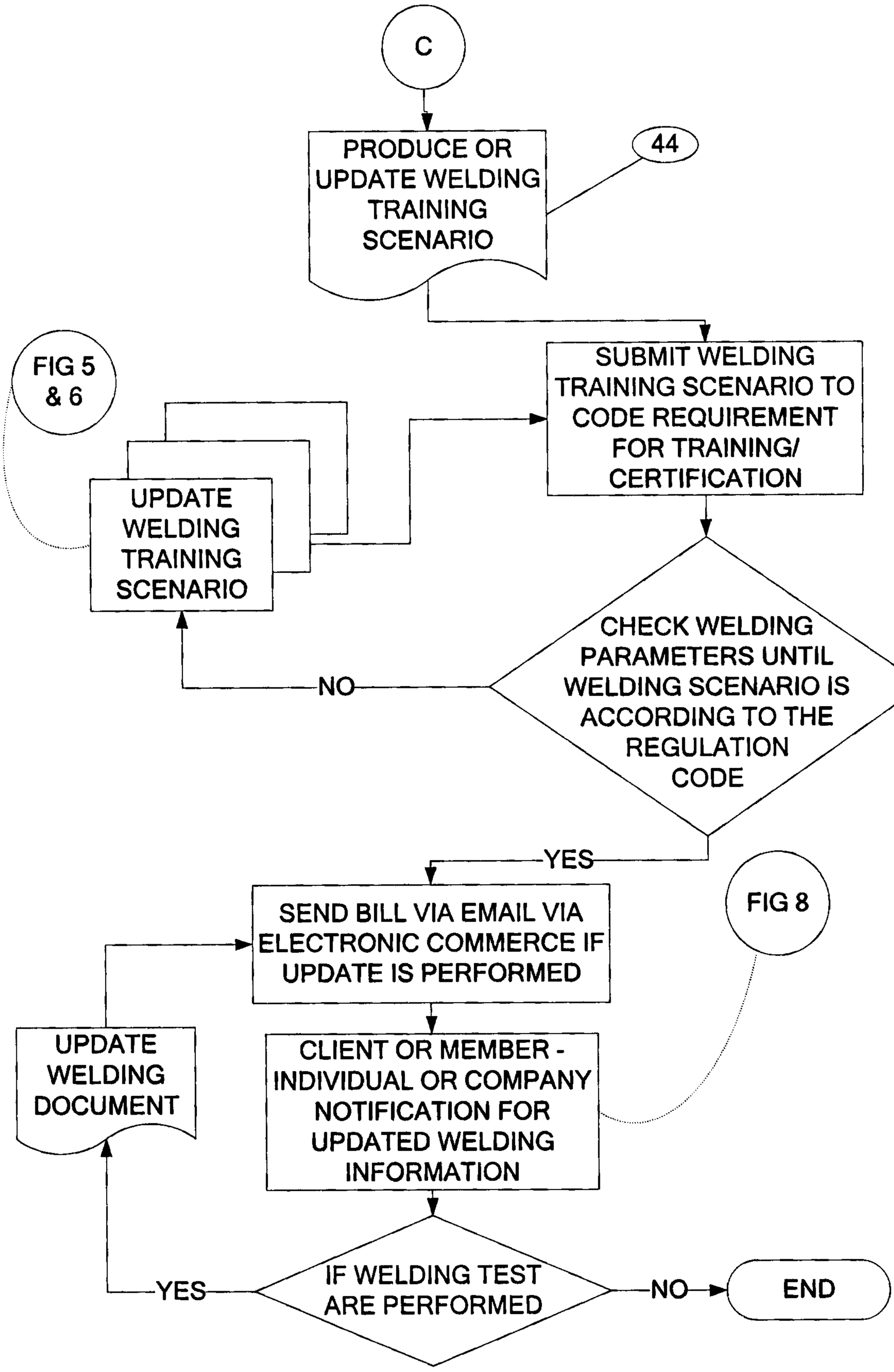


FIG. 4 (Continuity)

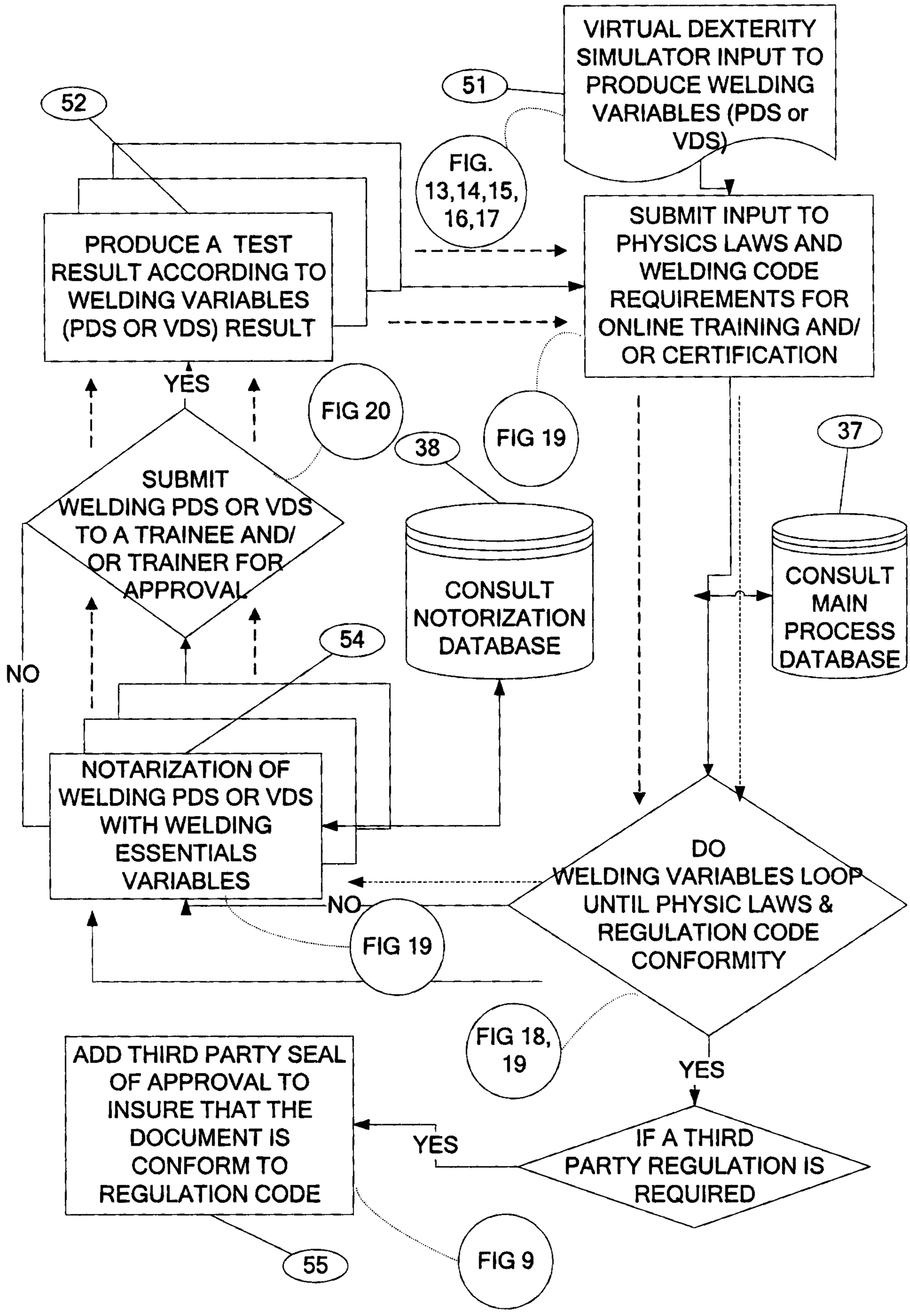

VIRTUAL DEXTERITY SIMULATOR INPUT TO PRODUCE WELDING VARIABLES (PDS or VDS)
51
52
FIG. 13,14,15, 16,17
PRODUCE A TEST RESULT ACCORDING TO WELDING VARIABLES (PDS OR VDS) RESULT
SUBMIT INPUT TO PHYSICS LAWS AND WELDING CODE REQUIREMENTS FOR ONLINE TRAINING AND/ OR CERTIFICATION
YES
FIG 20
FIG 19
38
37
SUBMIT WELDING PDS OR VDS TO A TRAINEE AND/ OR TRAINER FOR APPROVAL
CONSULT NOTORIZATION DATABASE
CONSULT MAIN PROCESS DATABASE
54
NO
NOTARIZATION OF WELDING PDS OR VDS WITH WELDING ESSENTIALS VARIABLES
DO WELDING VARIABLES LOOP UNTIL PHYSIC LAWS & REGULATION CODE CONFORMITY
NO
FIG 19
FIG 18, 19
YES
ADD THIRD PARTY SEAL OF APPROVAL TO INSURE THAT THE DOCUMENT IS CONFORM TO REGULATION CODE
YES
IF A THIRD PARTY REGULATION IS REQUIRED
55
FIG 9

FIG. 5

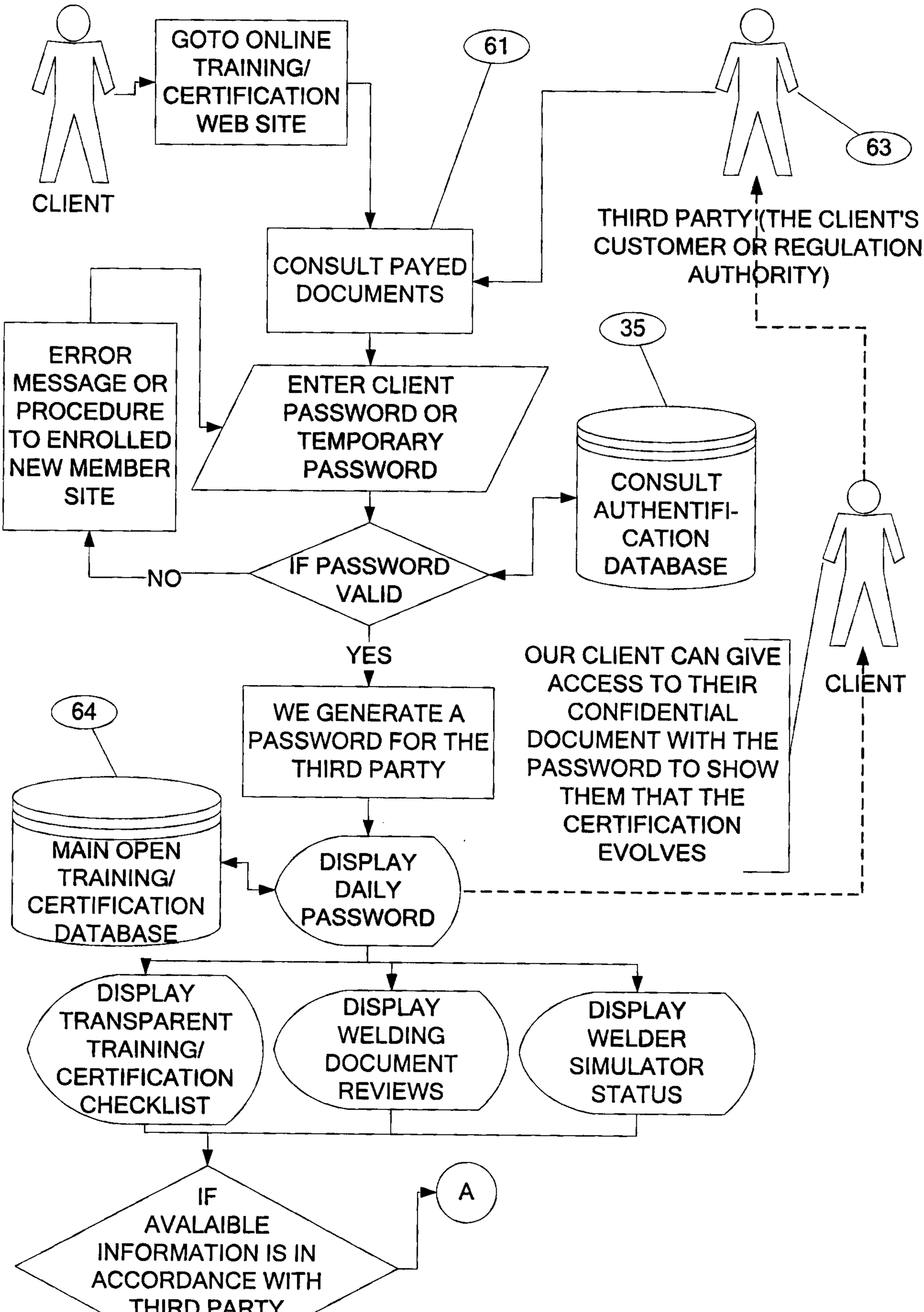

CLIENT
GOTO ONLINE TRAINING/ CERTIFICATION WEB SITE
61
CONSULT PAYED DOCUMENTS
ERROR MESSAGE OR PROCEDURE TO ENROLLED NEW MEMBER SITE
ENTER CLIENT PASSWORD OR TEMPORARY PASSWORD
IF PASSWORD VALID
NO
YES
THIRD PARTY (THE CLIENT'S CUSTOMER OR REGULATION AUTHORITY)
63
35
CONSULT AUTHENTIFI-CATION DATABASE
CLIENT
OUR CLIENT CAN GIVE ACCESS TO THEIR CONFIDENTIAL DOCUMENT WITH THE PASSWORD TO SHOW THEM THAT THE CERTIFICATION EVOLVES
64
WE GENERATE A PASSWORD FOR THE THIRD PARTY
MAIN OPEN TRAINING/ CERTIFICATION DATABASE
DISPLAY DAILY PASSWORD
DISPLAY TRANSPARENT TRAINING/ CERTIFICATION CHECKLIST
DISPLAY WELDING DOCUMENT REVIEWS
DISPLAY WELDER SIMULATOR STATUS
IF AVALAIBLE INFORMATION IS IN ACCORDANCE WITH THIRD PARTY REQUEST
A

FIG. 6

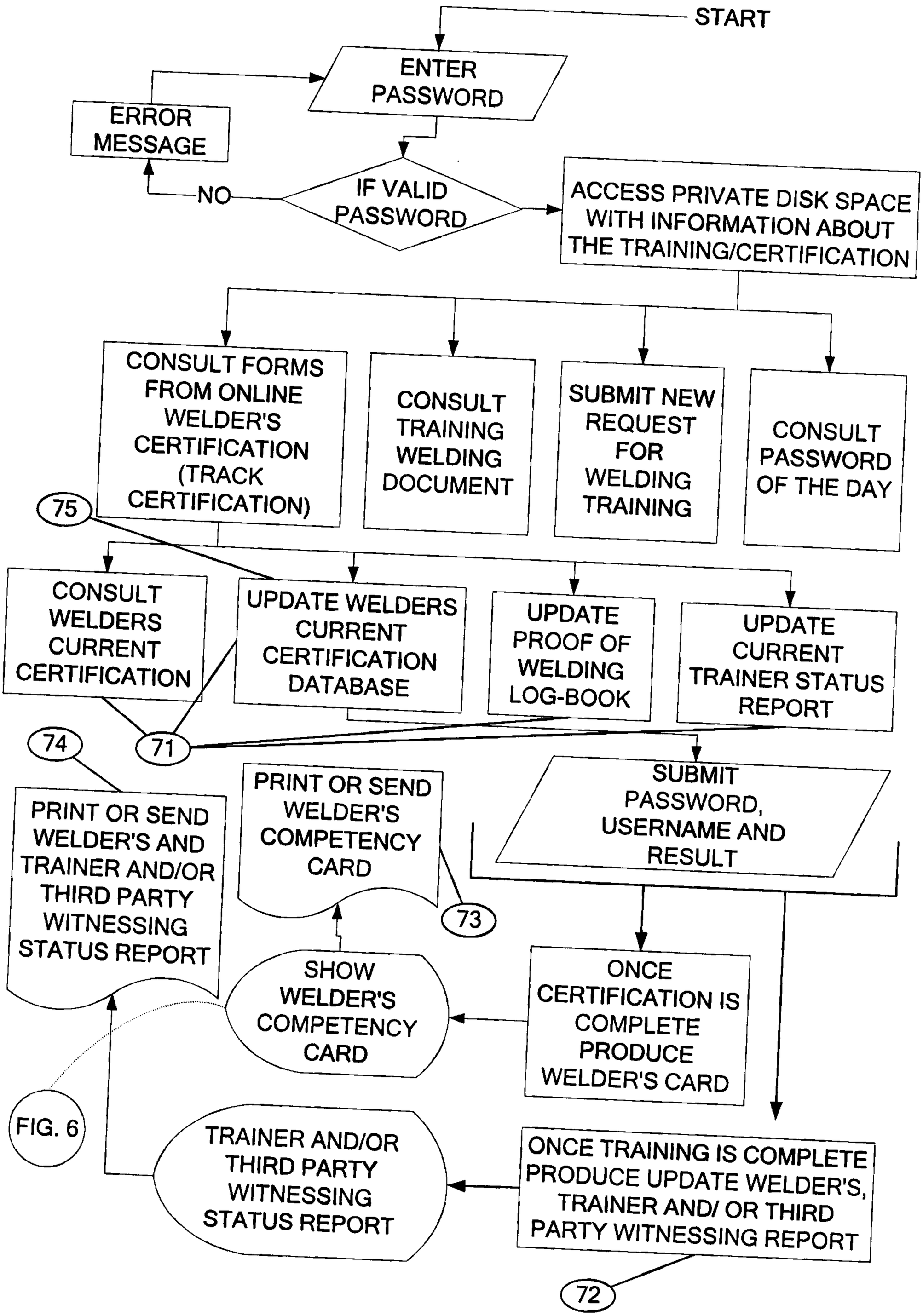

START
ENTER PASSWORD
ERROR MESSAGE
NO
IF VALID PASSWORD
ACCESS PRIVATE DISK SPACE WITH INFORMATION ABOUT THE TRAINING/CERTIFICATION
CONSULT FORMS FROM ONLINE WELDER'S CERTIFICATION (TRACK CERTIFICATION)
CONSULT TRAINING WELDING DOCUMENT
SUBMIT NEW REQUEST FOR WELDING TRAINING
CONSULT PASSWORD OF THE DAY
75
CONSULT WELDERS CURRENT CERTIFICATION
UPDATE WELDERS CURRENT CERTIFICATION DATABASE
UPDATE PROOF OF WELDING LOG-BOOK
UPDATE CURRENT TRAINER STATUS REPORT
74
71
PRINT OR SEND WELDER'S AND TRAINER AND/OR THIRD PARTY WITNESSING STATUS REPORT
PRINT OR SEND WELDER'S COMPETENCY CARD
73
SUBMIT PASSWORD, USERNAME AND RESULT
SHOW WELDER'S COMPETENCY CARD
ONCE CERTIFICATION IS COMPLETE PRODUCE WELDER'S CARD
FIG. 6
TRAINER AND/OR THIRD PARTY WITNESSING STATUS REPORT
ONCE TRAINING IS COMPLETE PRODUCE UPDATE WELDER'S, TRAINER AND/ OR THIRD PARTY WITNESSING REPORT
72

FIG. 7

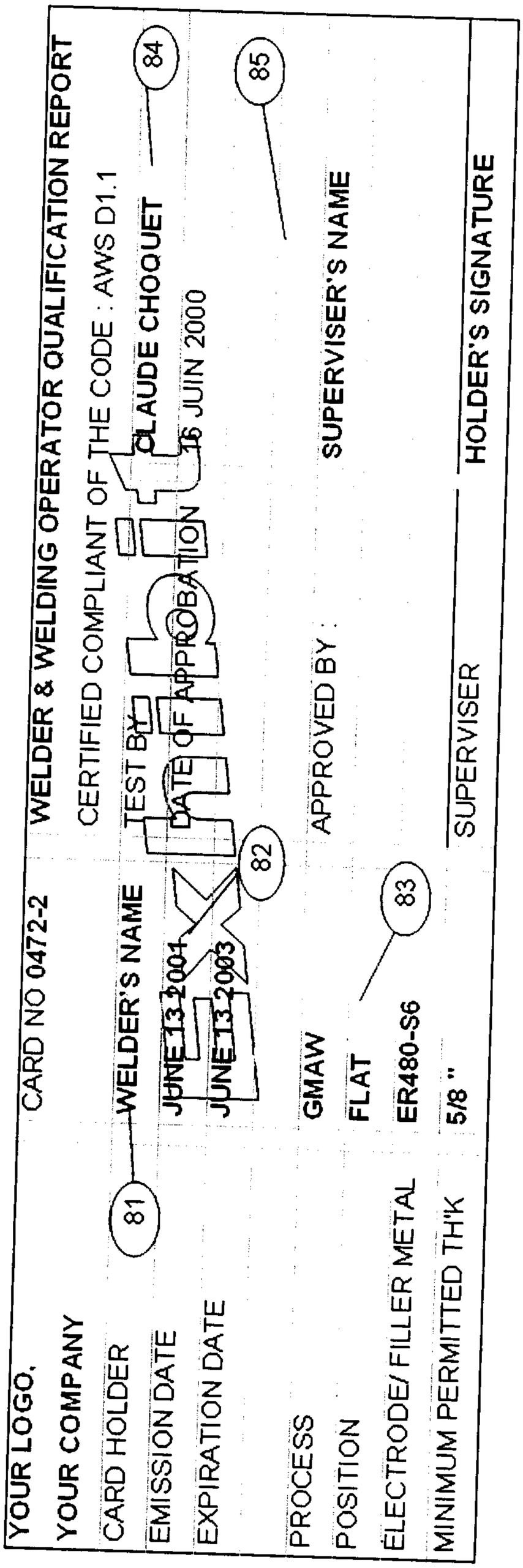

WELDER & WELDING OPERATOR QUALIFICATION REPORT
CARD NO 0472-2
YOUR LOGO.
YOUR COMPANY
CARD HOLDER
EMISSION DATE
EXPIRATION DATE
PROCESS
POSITION
ELECTRODE/ FILLER METAL
MINIMUM PERMITTED TH'K
CERTIFIED COMPLIANT OF THE CODE : AWS D1.1
TEST BY
DATE OF APPROBATION
APPROVED BY :
SUPERVISER
WELDER'S NAME
JUNE 13 2001
JUNE 13 2003
GMAW
FLAT
ER480-S6
5/8 "
CLAUDE CHOQUET
16 JUIN 2000
SUPERVISER'S NAME
HOLDER'S SIGNATURE
81
82
83
84
85

FIG. 8

91

EVOLUTION OF THE ONLINE CERTIFICATION				
WELDER NAME				
BASE METAL :		FILLER METAL:		
DATE :		WELDER TEST REF.:		
ITEM NO	OPERATION		RESP.	DIGITAL PRINT
1	GET THE BASE METAL ACCORDING TO THE CODE TEST		AW	UPDATE
2	GET THE FILLER METAL ACCORDING TO THE CODE TEST		AW	UPDATE
3	REVIEW THE WELDING DATA SHEET WITH THE WELDING ENGINEER		WE	UPDATE
4	PREPARATION OF THE ASSEMBLY (CHAMFERING AND TACKING)		AW	UPDATE
5	PUNCH THE ASSEMBLY		AW	UPDATE
6	GET IN CONTACT WITH THE WELDING ENGINEER		AW	UPDATE
7	VERIFICATION OF THE PREPARATION BY THE		AW	UPDATE
[illegible]	[illegible]		AW	[illegible]
16	- BENDING			[illegible]
17	- EVALUATION OF THE RESULTS		AW	UPDATE
18	ACCEPTED ☐ REFUSED ☐		WE	UPDATE
19	IF TEST BY X-RAY ACCEPTED ☐ REFUSED ☐		LABO	UPDATE
20	ASSESSMENT OF THE RESULTS BY THE RESPONSIBLE PERSON		AW	UPDATE
21	TRANSCRIBE THE RESULTS ON THE B AND D FORMS		AW	UPDATE
22	TRANSMISSION OF THE RESULTS TO THE DIFFERENT INTERVENING PARTIES		AW	UPDATE

92

93

CERTIFICATION STATUS DATED OF: 07-04-03 15:39:32

LEGEND : W: WELDER; WE: WELDING ENGINEER; AW: AUTHORIZED WORKER; LABO: LABORATORY

94

95

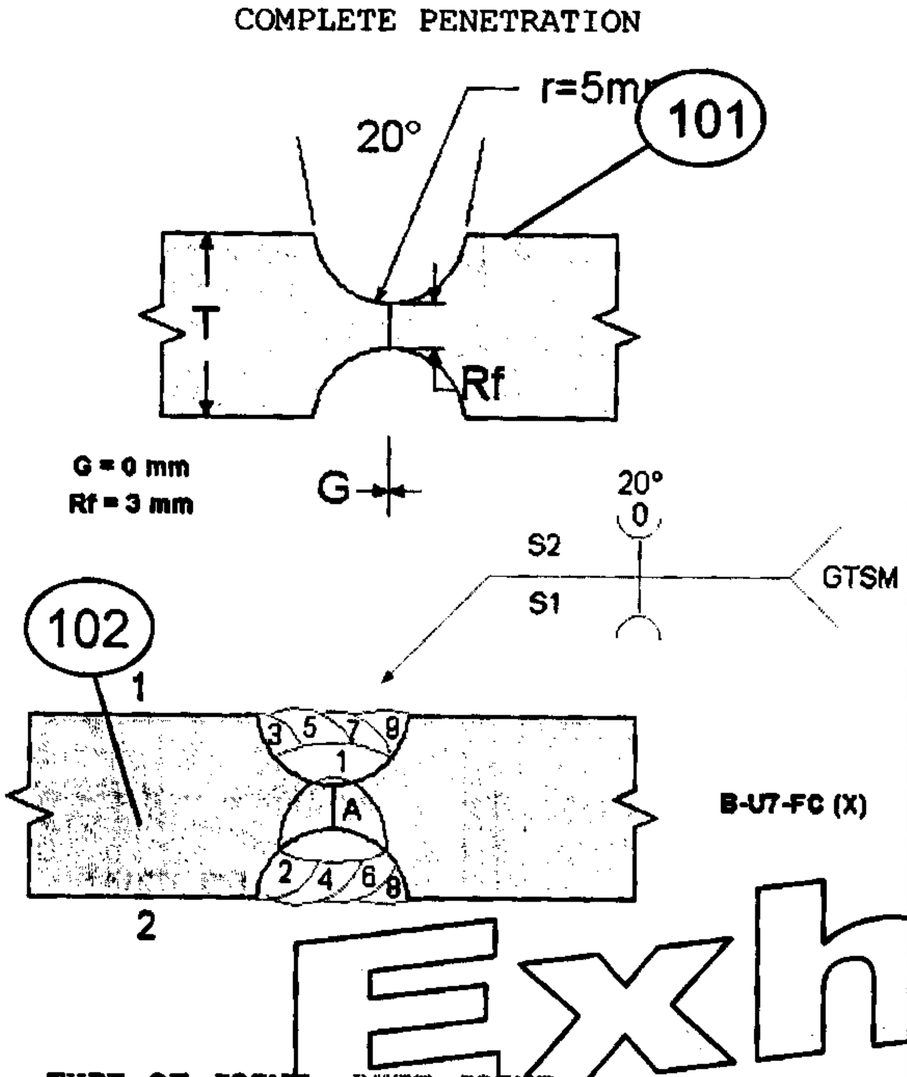
96

97

FIG. 9

WELDING DATA SHEET	NO: **F7-1 B1 12 25-5**	SECTION ...3.0..... PART .**E480XT-9 CH.** PAGE .....-..... DATE ...june 20 2001 REVISION ...0.....

COMPLETE PENETRATION



TYPE OF JOINT BUTT JOINT
U-GROOVE WITH BACK GOUGING

MATERIAL	**STEEL**
BASE METAL **TABLE 11.1 GR. 1,2,3, CODE CSA W59**	
FILLER METAL **E4802T-9 CH**	
FILLER METAL-GAS COMBINATION **SEE NOTE 6**	
GAS: **15-25 L/MIN(35-50 CFH)**	103
GAS: **75% Argon + 25% CO2**	
WELDING PROCEDURE (SECTION 2.0)	
PROCESS **FCAW SEMI-AUTOMATIC**	
CURRENT **CC(ELEC +)** STICK-OUT **15-25**	
POSITION **FLAT**	
PREHEAT NONE, **PAR. 2.2.10 & TAB 5.3 W59**	
BACK GOUGING FOR JCP **APPLICABLE**(4)	

104

T MM (IN.)	FIG NO	LAYER NO (2)	PASS NO (2)	ELECTRODE DIAM. MM (IN.)	AMPERES	VOLTS	WELDING SPEED MM (IN.)/MIN	WIRE SPEED (IN./MIN)	RATE DEPOSITION (LB/HRS)
15(5/8)	1 2	1 4	1 2	1.2 "	300-370 "	26-30 "	250-325(10-13) 250-325(10-13)	445	11.46
25(1)	1 2	1-3 4	1-3-5-7-9 2-4-6-8	" "	300-370 "	26-30 "	200-300(09-12) 200-300(09-12)	445	11.46
FOR ALL	2	2	A	"	"	"	200-300(09-12)	"	"

NOTE (1): THE WELDING SPEED IS GIVEN AS A REFERENCE OR A GUIDE BECAUSE IT IS FUNCTION OF CURRENT, VOLTAGE AND SIZE OF WELD REQUIRED OR DEPOSITED:
GO TO PARA 2.2.12 FOR ALLOWED RANGE.
(2): THE NUMBER OF PASSES AND LAYERS CAN BE GREATER AND IS ADJUSTED WHEN REQUIRED DEPENDING OF THE NEEDS FOR INTERMEDIATES DIMENSIONS. VOIR PARA 2.2.12 FOR ALLOWED RANGE.
(3): GO TO PARA 2.2.12 FOR THE ALLOWABLE RANGE IN VARIABLES (AMPS., VOLT, GAS).
(4) : GO TO PARA 2.2.12 FOR WELDING TECHNIQUE
(5) : THE WELDING SPEED IS AN AVERAGE VALUE FOR ALL PASSES OF EACH SIDE.
(6) : THE FILLER METAL - GAS COMBINATION MUST BE APPROVED.

FIG. 10

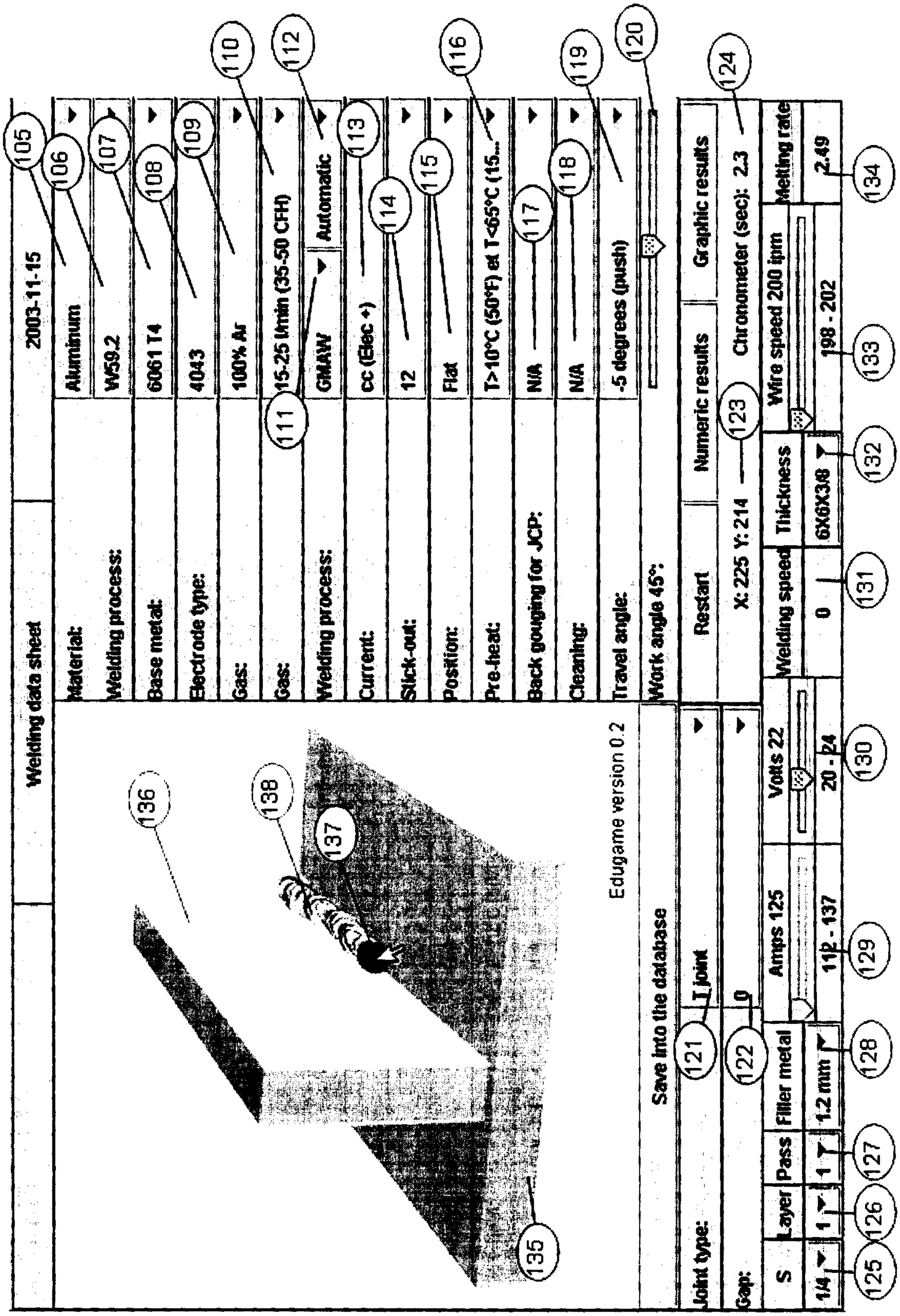

105
106
107
108
109
110
111
112
113
114
115
116
117
118
119
120
121
122
123
124
125
126
127
128
129
130
131
132
133
134
135
136
137
138
Welding data sheet
2003-11-15
Material:
Aluminum
Welding process:
W59.2
Base metal:
6061 T4
Electrode type:
4043
Gas:
100% Ar
Gas:
15-25 l/min (35-50 CFH)
Automatic
Welding process:
GMAW
Current:
cc (Elec +)
Stick-out:
12
Position:
Flat
Pre-heat:
T>10°C (50°F) et T<65°C (15...
Back gouging for JCP:
N/A
Cleaning:
N/A
Travel angle:
-5 degrees (push)
Work angle 45°:
Restart
Numeric results
Graphic results
X: 225 Y: 214
Chronometer (sec): 2.3
Welding speed
Thickness
Wire speed 200 ipm
Melting rate
0
6X6X3/8
198 - 202
2.49
Edugame version 0.2
Save into the database
T joint
0
Filler metal
Amps 125
Volts 22
1.2 mm
112 - 137
20 - 24
Joint type:
Gap:
S
Layer
Pass
1/4
1
1

FIG. 11

FIG. 12

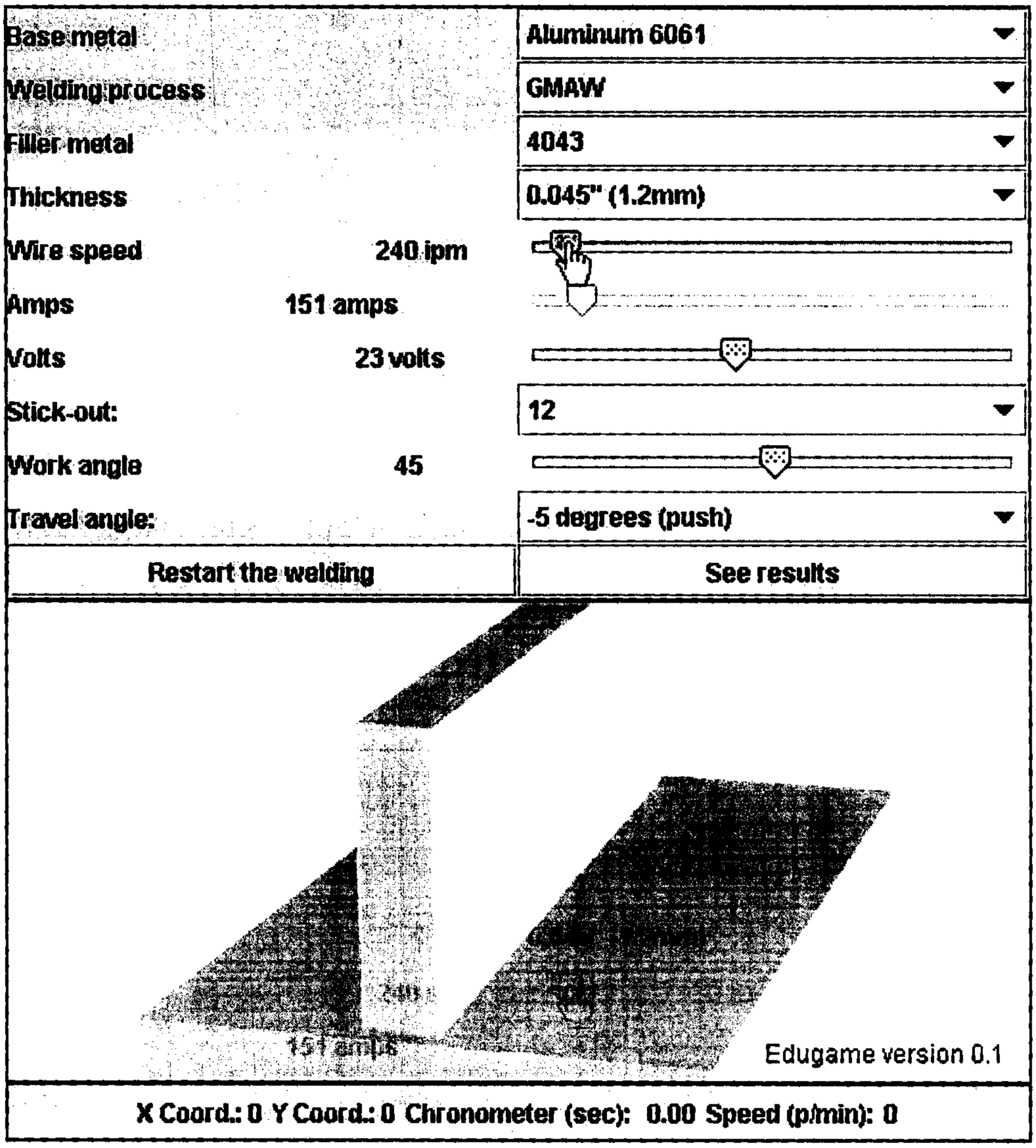

Base metal
Aluminum 6061
Welding process
GMAW
Filler metal
4043
Thickness
0.045" (1.2mm)
Wire speed
240 ipm
Amps
151 amps
Volts
23 volts
Stick-out:
12
Work angle
45
Travel angle:
-5 degrees (push)
Restart the welding
See results
151 amps
Edugame version 0.1
X Coord.: 0 Y Coord.: 0 Chronometer (sec): 0.00 Speed (p/min): 0

FIG. 13

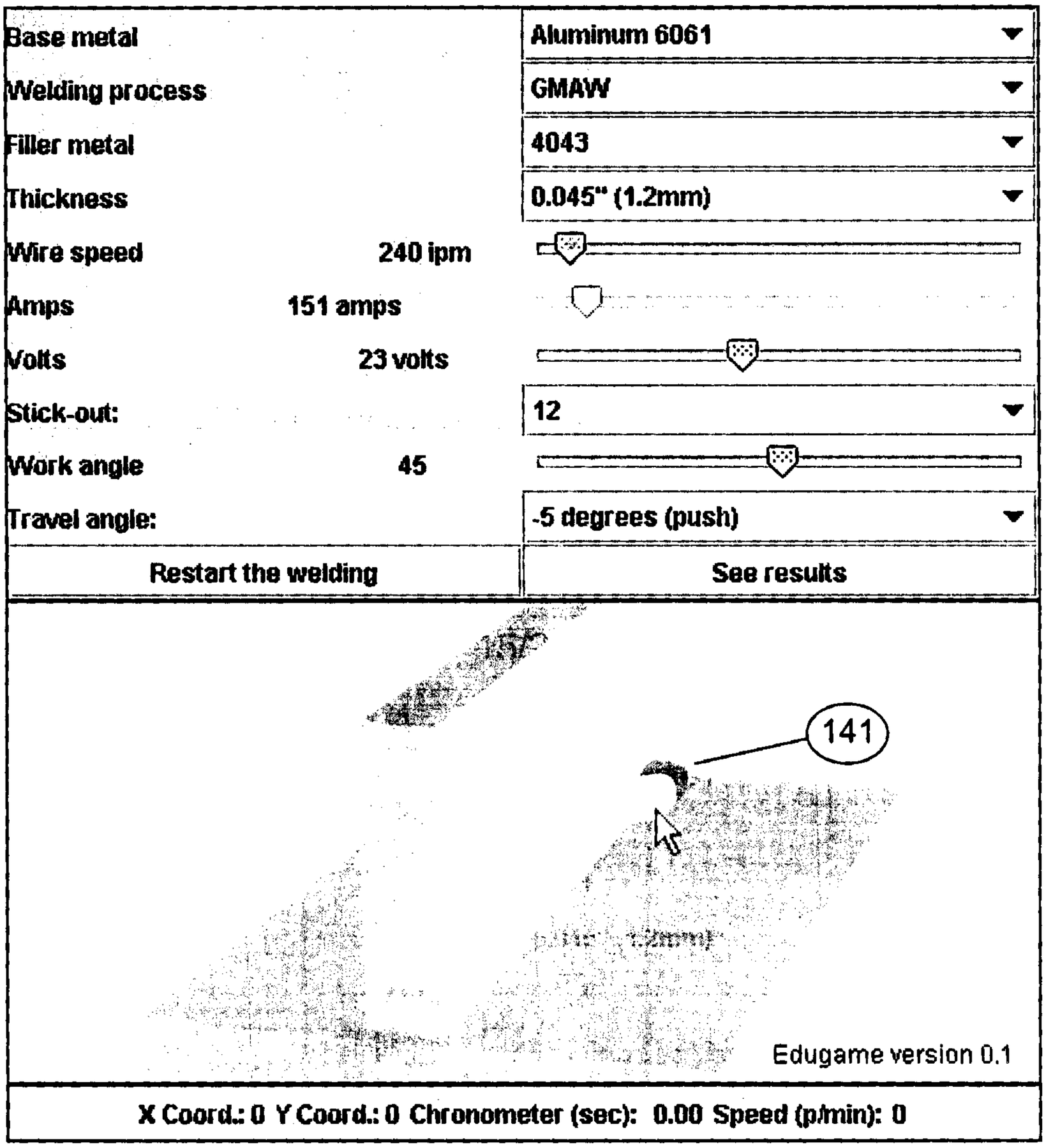

Base metal
Aluminum 6061
Welding process
GMAW
Filler metal
4043
Thickness
0.045" (1.2mm)
Wire speed
240 ipm
Amps
151 amps
Volts
23 volts
Stick-out:
12
Work angle
45
Travel angle:
-5 degrees (push)
Restart the welding
See results
141
Edugame version 0.1
X Coord.: 0 Y Coord.: 0 Chronometer (sec): 0.00 Speed (p/min): 0

FIG. 14

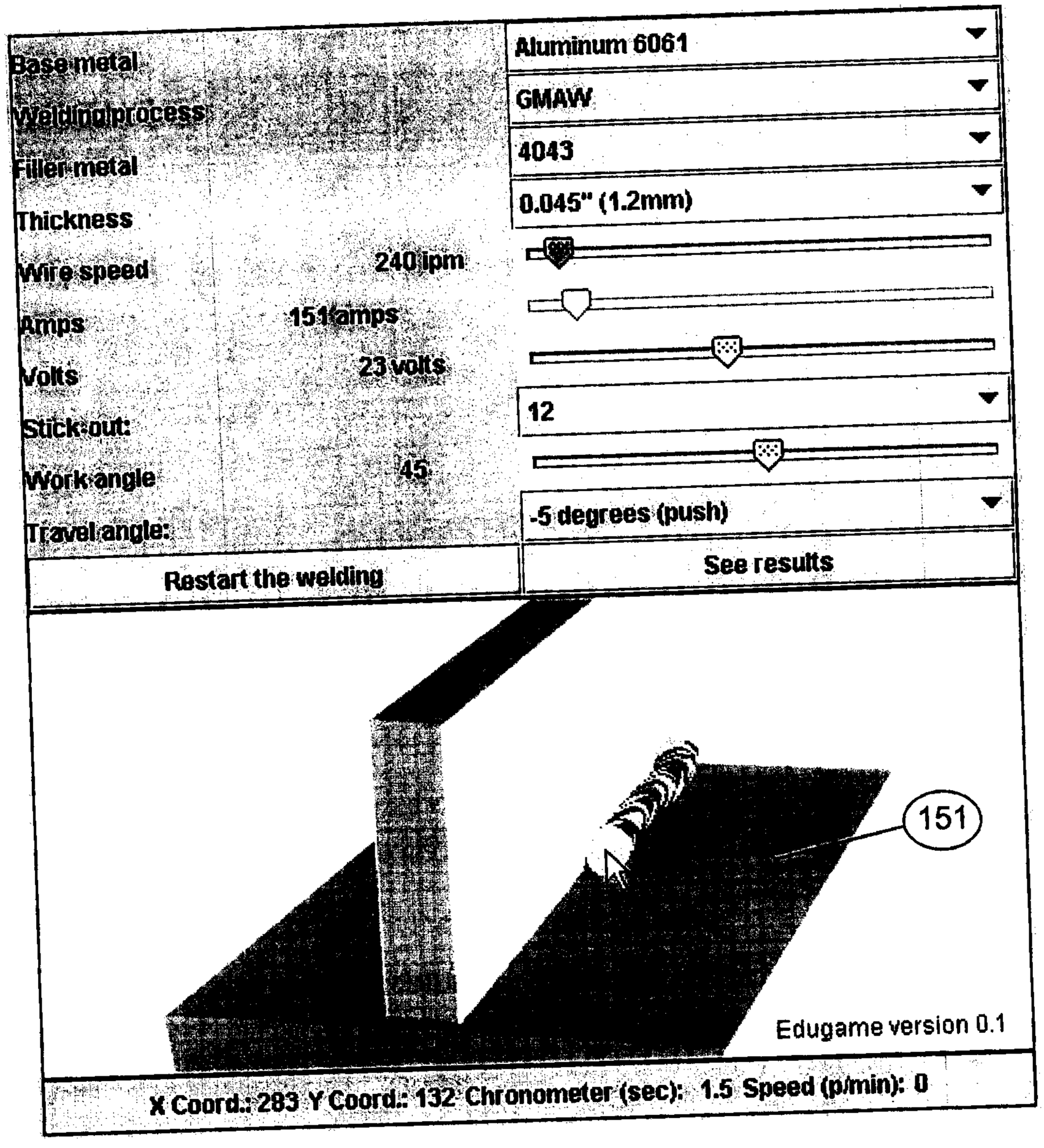

Base metal
Aluminum 6061
Welding process
GMAW
Filler metal
4043
Thickness
0.045" (1.2mm)
Wire speed
240 ipm
Amps
151 amps
Volts
23 volts
Stick-out:
12
Work angle
45
Travel angle:
-5 degrees (push)
Restart the welding
See results
151
Edugame version 0.1
X Coord.: 283 Y Coord.: 132 Chronometer (sec): 1.5 Speed (p/min): 0

FIG. 15

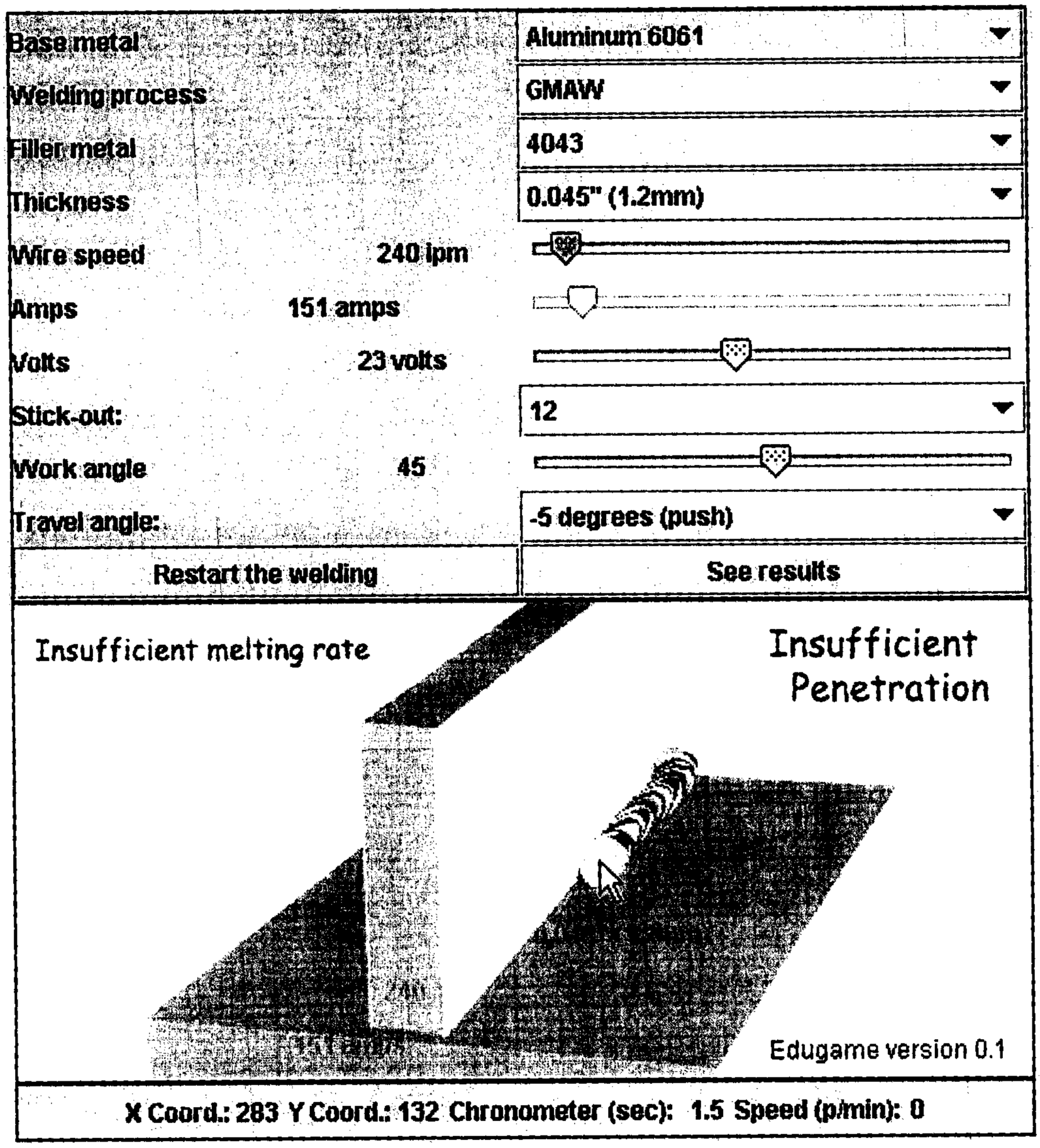

Base metal
Aluminum 6061
Welding process
GMAW
Filler metal
4043
Thickness
0.045" (1.2mm)
Wire speed
240 ipm
Amps
151 amps
Volts
23 volts
Stick-out:
12
Work angle
45
Travel angle:
-5 degrees (push)
Restart the welding
See results
Insufficient melting rate
Insufficient Penetration
Edugame version 0.1
X Coord.: 283 Y Coord.: 132 Chronometer (sec): 1.5 Speed (p/min): 0

FIG. 16

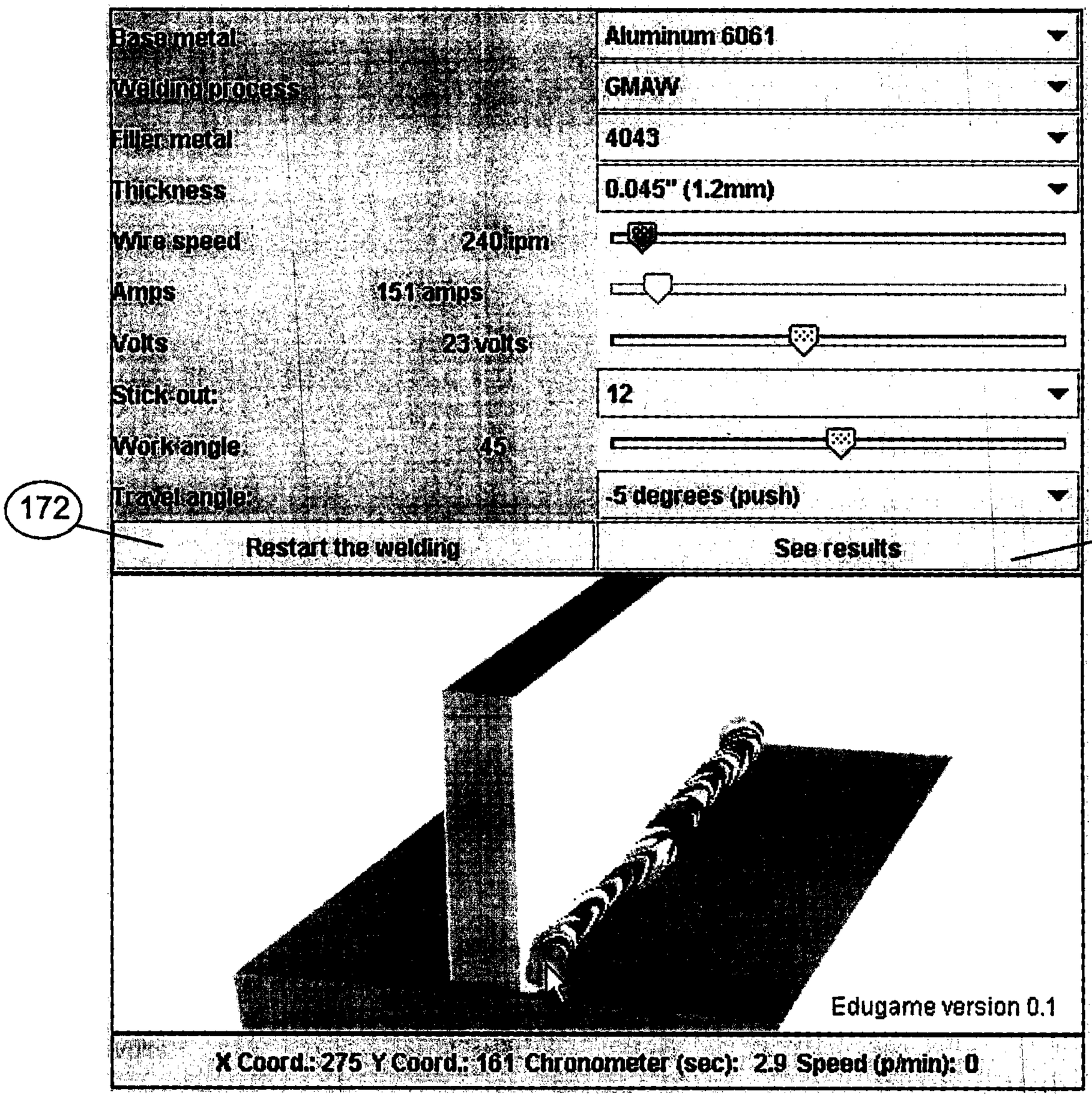

Base metal
Aluminum 6061
Welding process
GMAW
Filler metal
4043
Thickness
0.045" (1.2mm)
Wire speed
240 ipm
Amps
151 amps
Volts
23 volts
Stick-out:
12
Work angle
45
Travel angle:
-5 degrees (push)
172
Restart the welding
See results
171
Edugame version 0.1
X Coord.: 275 Y Coord.: 161 Chronometer (sec): 2.9 Speed (p/min): 0

FIG. 17

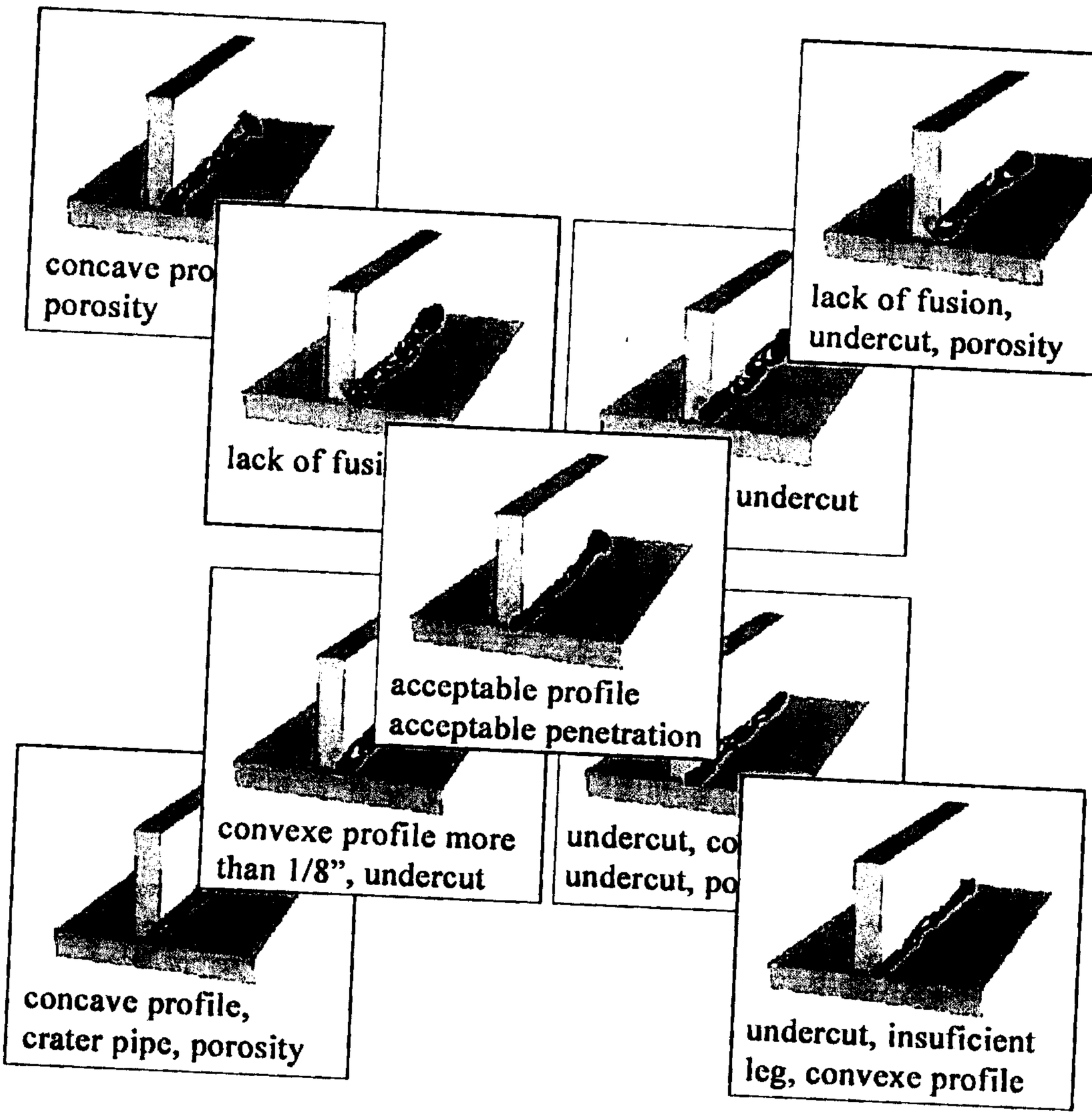

concave pro
porosity
lack of fusion,
undercut, porosity
lack of fusi
undercut
acceptable profile
acceptable penetration
convexe profile more
than 1/8", undercut
undercut, co
undercut, po
concave profile,
crater pipe, porosity
undercut, insuficient
leg, convexe profile

FIG. 18

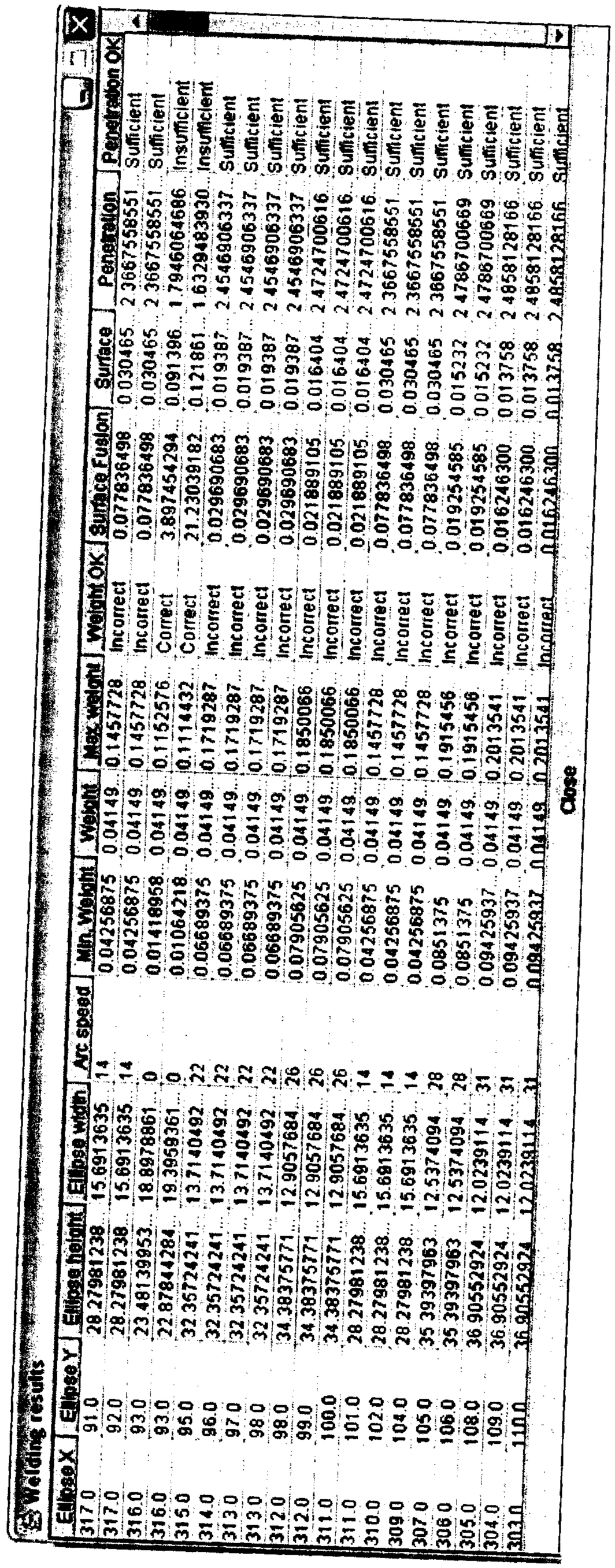

Welding results
EllipseX EllipseY Ellipse height Ellipse width Arc speed Min. Weight
317.0 91.0 28.27981238 15.6913635 14 0.04256875
317.0 92.0 28.27981238 15.6913635 14 0.04256875
316.0 93.0 23.48139953 18.8978861 0 0.01418958
316.0 93.0 22.87844284 19.3959361 0 0.01064218
315.0 95.0 32.35724241 13.7140492 22 0.06689375
314.0 96.0 32.35724241 13.7140492 22 0.06689375
313.0 97.0 32.35724241 13.7140492 22 0.06689375
313.0 98.0 32.35724241 13.7140492 22 0.06689375
312.0 98.0 34.38375771 12.9057684 26 0.07905625
312.0 99.0 34.38375771 12.9057684 26 0.07905625
311.0 100.0 28.27981238 15.6913635 14 0.04256875
311.0 101.0 35.39397963 12.5374094 28 0.0851375
310.0 102.0 35.39397963 12.5374094 28 0.0851375
309.0 104.0 36.90552924 12.0239114 31 0.09425937
307.0 105.0 36.90552924 12.0239114 31 0.09425937
306.0 106.0 36.90552924 12.0239114 31 0.09425937
305.0 108.0 36.90552924 12.0239114 31 0.09425937
304.0 109.0 36.90552924 12.0239114 31 0.09425937
303.0 110.0 36.90552924 12.0239114 31 0.09425937
Weight Max weight Weight OK Surface Fusion Surface
0.04149 0.1457728 Incorrect 0.077836498 0.030465
0.04149 0.1457728 Incorrect 0.077836498 0.030465
0.04149 0.1152576 Correct 3.897454294 0.091396
0.04149 0.1114432 Correct 21.23039182 0.121861
0.04149 0.1719287 Incorrect 0.029690683 0.019387
0.04149 0.1719287 Incorrect 0.029690683 0.019387
0.04149 0.1719287 Incorrect 0.029690683 0.019387
0.04149 0.1719287 Incorrect 0.029690683 0.019387
0.04149 0.1850066 Incorrect 0.021889105 0.016404
0.04149 0.1850066 Incorrect 0.021889105 0.016404
0.04149 0.1850066 Incorrect 0.021889105 0.016404
0.04149 0.1457728 Incorrect 0.077836498 0.030465
0.04149 0.1457728 Incorrect 0.077836498 0.030465
0.04149 0.1457728 Incorrect 0.077836498 0.030465
0.04149 0.1915456 Incorrect 0.019254585 0.015232
0.04149 0.1915456 Incorrect 0.019254585 0.015232
0.04149 0.2013541 Incorrect 0.016246300 0.013758
0.04149 0.2013541 Incorrect 0.016246300 0.013758
0.04149 0.2013541 Incorrect 0.016246300 0.013758
Close

FIG. 19

WELDING TEST #5 (on 7)

	test 1	test 2	test 3	test 4
Vincent Viau	5	5	5	7
Sébastion Lapierre	4	7	7	7
Ezio Radeschi	6	7	7	
Raymond Tremblay	3			

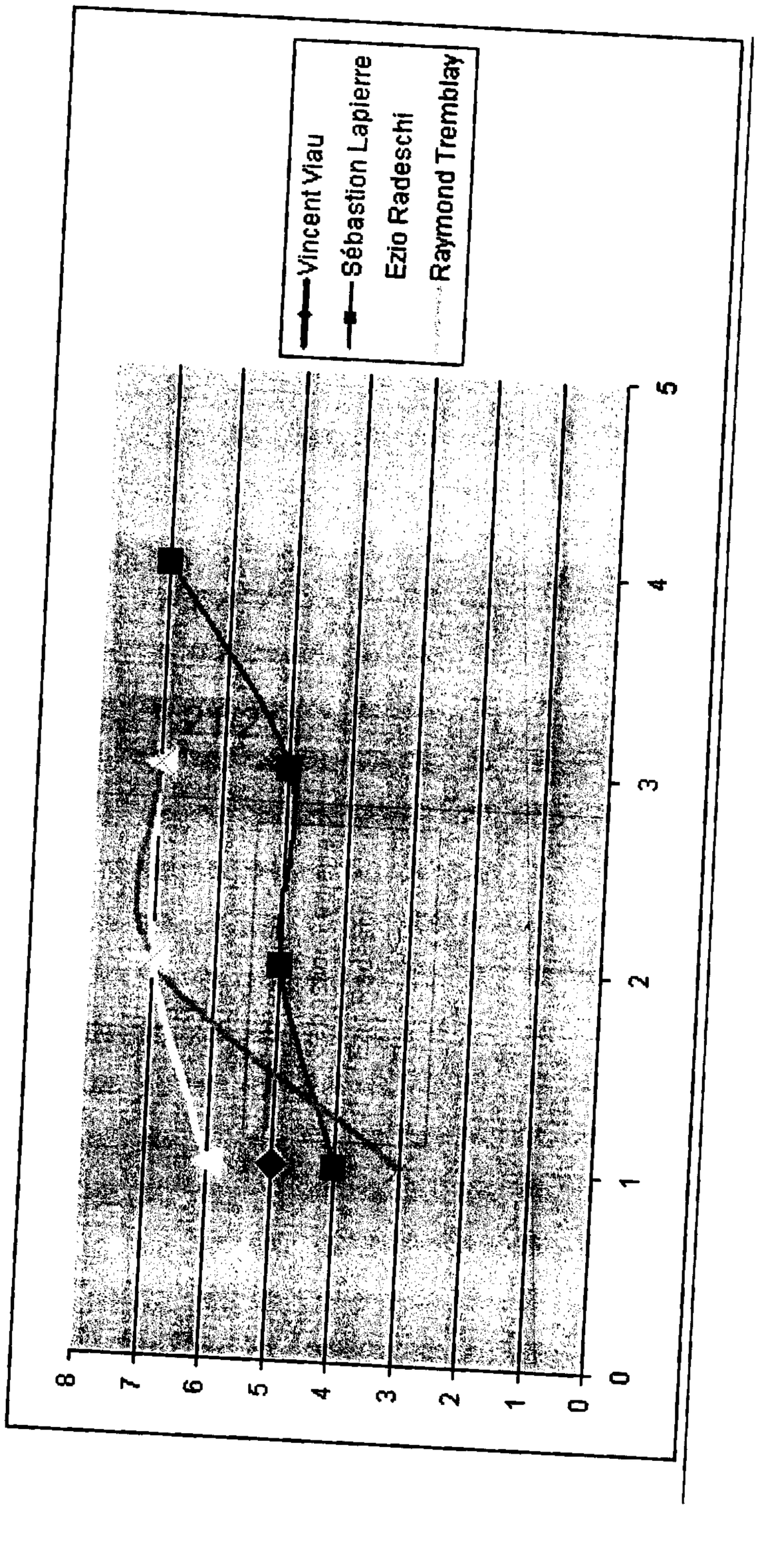
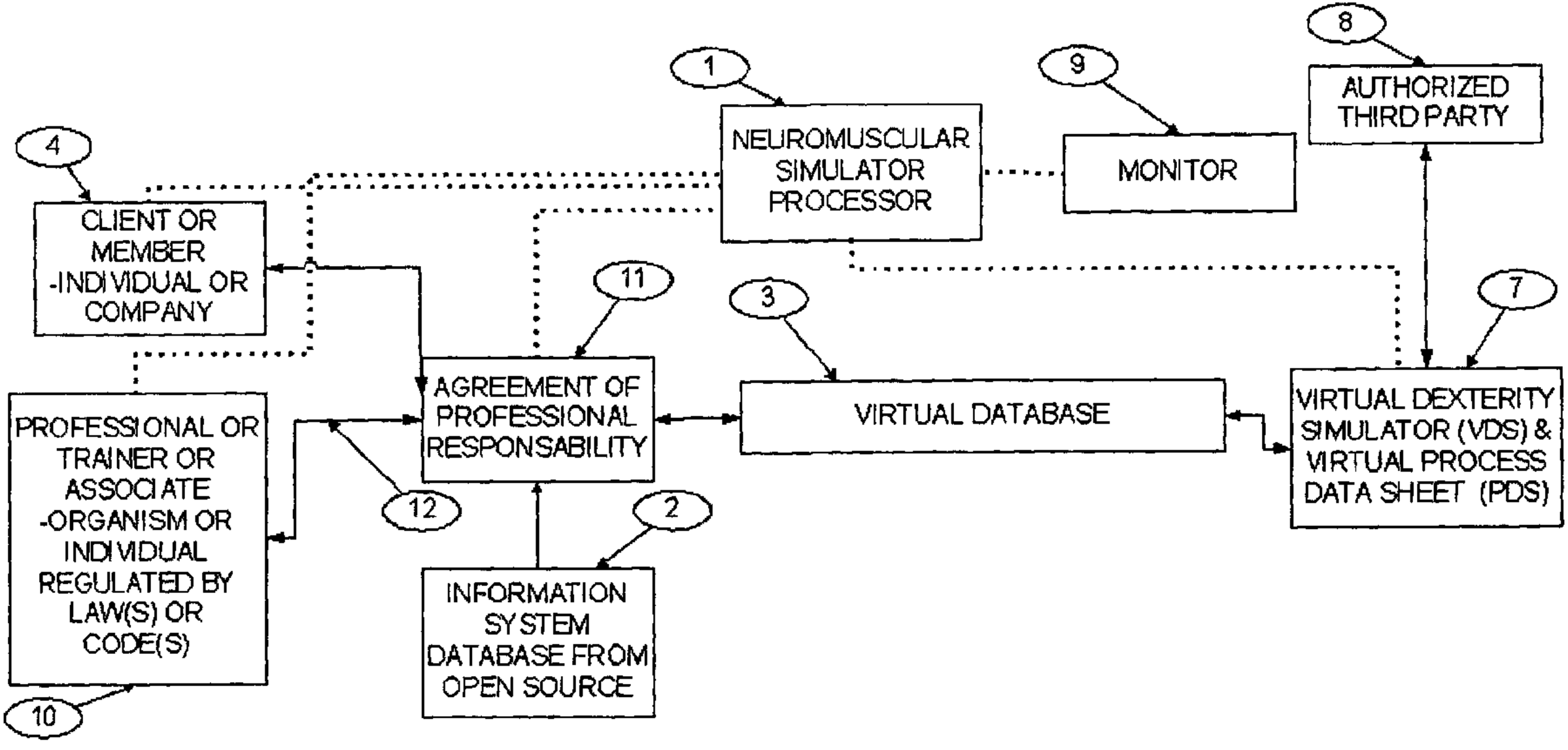


FIG. 20


1
NEUROMUSCULAR SIMULATOR PROCESSOR
9
MONITOR
8
AUTHORIZED THIRD PARTY
4
CLIENT OR MEMBER -INDIVIDUAL OR COMPANY
11
AGREEMENT OF PROFESSIONAL RESPONSABILITY
3
VIRTUAL DATABASE
7
VIRTUAL DEXTERITY SIMULATOR (VDS) & VIRTUAL PROCESS DATA SHEET (PDS)
PROFESSIONAL OR TRAINER OR ASSOCIATE -ORGANISM OR INDIVIDUAL REGULATED BY LAW(S) OR CODE(S)
12
2
INFORMATION SYSTEM DATABASE FROM OPEN SOURCE
10