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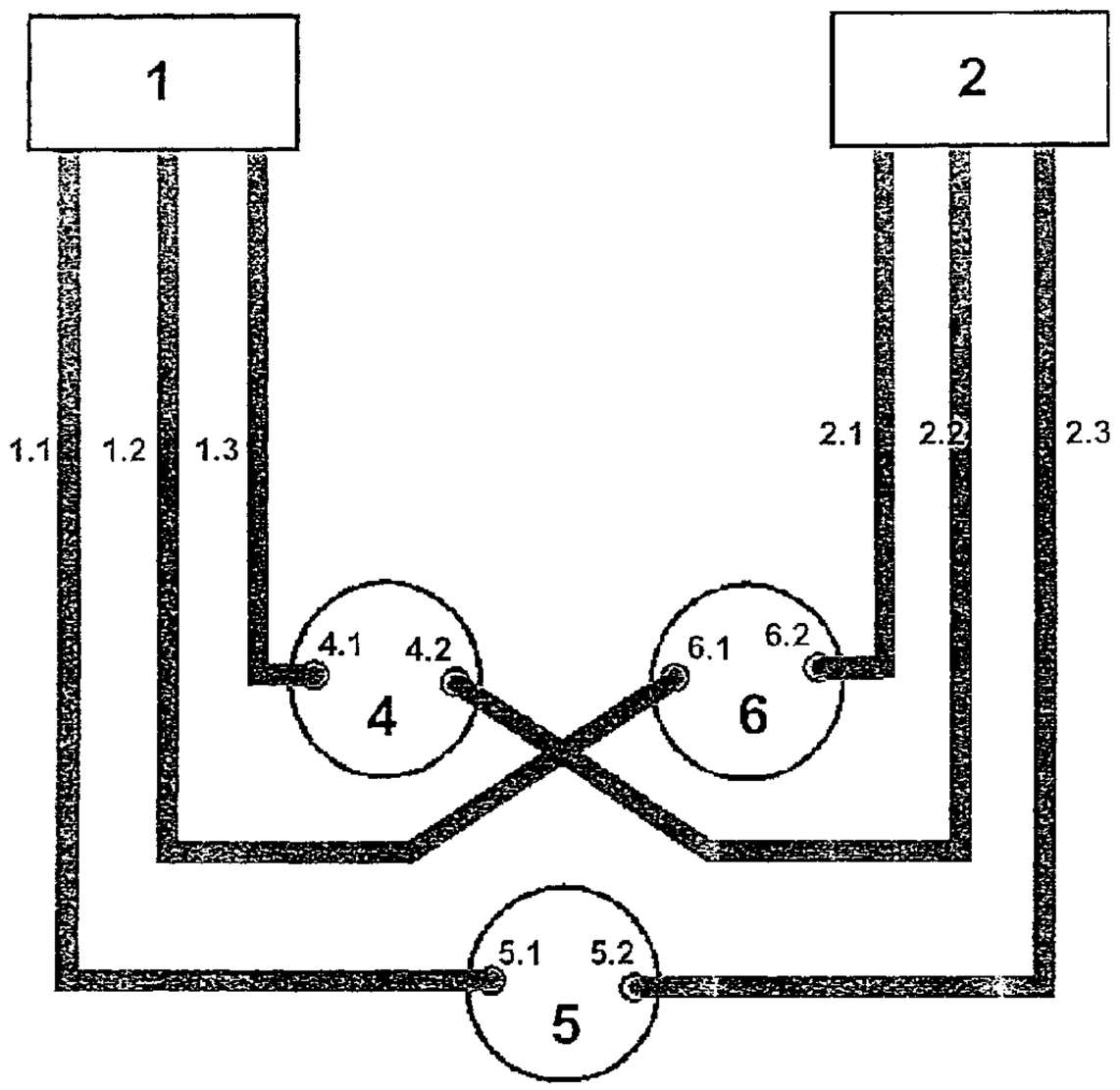
(72) Inventeurs/Inventors:
SCHINGNITZ, MANFRED, DE;
FISCHER, NORBERT, DE

(73) Propriétaire/Owner:
SIEMENS AKTIENGESELLSCHAFT, DE

(74) Agent: BORDEN LADNER GERVAIS LLP

(54) Titre : METHODE ET DISPOSITIF POUR REACTEUR A LIT ENTRAINE A GRAND RENDEMENT
(54) Title: METHOD AND DEVICE FOR HIGH-CAPACITY ENTRAINED FLOW GASIFIER



(57) Abrégé/Abstract:
The instant disclosure seeks to improve the availability of entrained flow reactors, for gasifying pulzerized fuel dusts, avoiding mere duplication of each lock hopper and dosing system. In particular, the expenditure for a full duplication of lock hoppers and dosing systems is avoided. In case one lock hopper and dosing systems fails, all burners are still supplied by the remaining lock hoppers and dosing systems; thus, an ongoing operation of all burners of the gasifier without crooked burning is performed. The method involves assigning each gasification burner to a set of locking and dosing systems with a set of delivered flows. Pressure lines are arranged between one of the basification burners and a locking and a dosing system. The gasification burners have supplies, where each supply of a respective gasification burner is connected to one of the locking and dosing systems by pressure lines.

ABSTRACT

The instant disclosure seeks to improve the availability of entrained flow reactors, for gasifying pulzerized fuel dusts, avoiding mere duplication of each lock hopper and dosing system. In particular, the expenditure for a full duplication of lock hoppers and dosing systems is avoided. In case one lock hopper and dosing systems fails, all burners are still supplied by the remaining lock hoppers and dosing systems; thus, an ongoing operation of all burners of the gasifier without crooked burning is performed. The method involves assigning each gasification burner to a set of locking and dosing systems with a set of delivered flows. Pressure lines are arranged between one of the basification burners and a locking and a dosing system. The gasification burners have supplies, where each supply of a respective gasification burner is connected to one of the locking and dosing systems by pressure lines.

Method and Device for High-capacity Entrained Flow Gasifier

Field of the Invention

The invention relates to a method for entrained flow gasification with very high capacity that can be used for supplying Large Scale syntheses with synthesis gas. The invention enables conversion of combustibles refined into pulverized combustible dusts, such as hard coal and lignite, petroleum coke, solid grindable residues but also solid-liquid suspensions, so-called slurries, into synthesis gas. The combustible is thereby converted through partial oxidation into CO- and H_2-containing gases at temperatures ranging from 1,200 to 1,900°C using a gasification agent containing free oxygen at pressures of up to 80 bar. This occurs in a gasification reactor distinguished by a multiple burner array and by a cooled gasification chamber.

Background of the Invention

In gas production techniques, the autothermal entrained flow gasification of solid, liquid and gaseous combustibles has been known for many years. For reasons of synthesis gas quality, the ratio of combustible to oxygen-containing gasification agents is chosen such that higher carbon compounds are completely cleaved into synthesis gas components, such as CO and H_2, and such that the inorganic constituents are discharged in the form of a molten slag.

According to different systems well known in the art, gasification gas and molten slag can be discharged separately or together from the reaction chamber of the gasification apparatus, as shown in DE 197 18 131 A1. Systems provided with a refractory lining or cooled systems are known for the internal confinement of the reaction chamber structure of the gasification system.

EP 0677 567 B1 and WO 96/17904 show a method in which the gasification chamber is confined by a refractory lining. This has the drawback that the refractory masonry is loosened by the liquid slag formed during gasification, which leads to rapid wear and high repair costs. This wear process increases with increasing ash content. Thus such gasification systems have a limited service life before replacing the lining. Also, the gasification temperature and the ash content of the fuel are limited; see C. Higman and M. van der Burgt, "Gasification", Verlag Elsevier, USA, 2003. A quenching or cooling system is also described, with which the hot gasification gas and

the liquid slag are carried off together through a conduit that begins at the bottom of the reaction chamber, and are fed into a water bath. This joint discharge of gasification gas and slag can lead to plugging of the conduit and thus to limitation of availability.

DE 3534015 A1 shows a method in which the gasification media, powdered fuel and oxidizing medium containing oxygen, are introduced into the reaction chamber symmetrically through multiple burners in such a way that the flames are mutually diverted. The gasification gas loaded with powdered dust flows upward and the slag flows downward into a slag-cooling system. As a rule, there is a device above the gasification chamber for indirect cooling utilizing the waste heat. However, because of entrained liquid slag particles there is the danger of deposition and coating of heat exchanger surfaces, which hinders heat transfer and may lead to plugging of the pipe system and/or erosion. The danger of plugging is counteracted by taking away the hot crude gas with a circulated cooling gas.

C. Higman and M. van der Burgt in "Gasification", page 124, Verlag Elsevier 2003, describe a method in which the hot gasification gas leaves the gasifier together with the liquid slag and directly enters a waste heat boiler positioned perpendicularly below it, in which the crude gas and the slag are cooled with utilization of the waste heat to produce steam. The slag is collected in a water bath, while the cooled crude gas leaves the waste heat boiler from the side. A series of drawbacks detract from the advantage of waste heat recovery by this system. To be mentioned here in particular is the formation of deposits on the heat exchanger tubes, which lead to hindrance of heat transfer and to corrosion and erosion, and thus to lack of availability.

CN 200 4200 200 7.1 describes a "Solid Pulverized Fuel Gasifier", in which the powdered coal is fed in pneumatically and gasification gas and liquefied slag are introduced into a water bath through a central pipe for further cooling. This central discharge in the central pipe mentioned is susceptible to plugging that interferes with the overall operation, and reduces the availability of the entire system.

The capacity of the various gasification technologies mentioned is limited to about 500 MW, which is attributable in particular to the fuel infeed to the gasification reactor.

It is the purpose of this invention, proceeding from this state of the art, to provide a gasification method that permits maximum capacities of 1,000 to 1,500 MW with reliable and safe operation.

Summary of the Invention

A preferred embodiment of the method in accordance with the invention includes the steps of: supplying the combustible dusts to multiple identically engaged metering systems that feed the dusts, through transport pipes to multiple gasification burners located at the head of a reactor, each gasification burner being associated with at least two lock hopper and dosing systems having a plurality of supply flows; igniting multiple dust burners with oxygen infeed in the head of the gasification reactor by ignition and pilot burners; determining the quantities of the dusts and oxygen fed to the dust burners, with the overall total of all amounts of dust and oxygen supplied being determined, and with a regulating mechanism assuring that the oxygen ratio neither exceeds nor falls below a ratio of 0.35 to 0.65, regardless of the distribution of dust and oxygen to the burners; converting the dusts in the gasification reactor at temperatures between 1,200 and 1,900°C and at pressures between atmospheric pressure and 80 bar, into a crude synthesis gas and slag; cooling down the hot crude gas at 1,200 to 1,900°C together with the slag to the condensation point at temperatures between 180°C and 240°C in a quenching cooler by injecting water; and feeding the cooled crude gas to further treatment stages such as water scrubbing, partial condensation, or catalytic processes.

A preferred apparatus in accordance with the invention is characterized in that supply lines are interposed between the gasification burners having feed ports and the lock hopper and dosing systems, supply lines leading from each lock hopper and dosing system to the feed port of every single gasification burner.

In high-performance entrained flow reactors, it is necessary to arrange a plurality of gasification burners if one wants to achieve secure conversion of the combustible. In order to ensure start up and secure operation of such reactors, a central ignition and pilot burner is disposed that is surrounded by 3 dust burners symmetrically spaced 120° apart from each other. In order to allow the introduction of large amounts of combustible dust, of for example 100-400 t/h, into the gasification reactor operated under pressure, a plurality of lock hopper and dosing systems are arranged for supplying dust to the gasification burners. It is possible to associate a lock hopper and dosing system with

each gasification burner. Most preferably each lock hopper and dosing system is connected to a plurality of gasification burners in order to increase reliability.

The solution of the invention provides a method in which at least two lock hopper and dosing systems are associated with each gasification burner. Supply lines lead from each lock hopper and dosing system to the feed ports in the various gasification burners. There may be less lock hopper and dosing systems than gasification burners. Two lock hopper and dosing systems may for example supply combustible to three gasification burners through lines. Furthermore, the supply lines of three lock hopper and dosing systems may lead to different gasification burners so that three gasification burners having each three feed ports may be provided, each feed port being supplied with combustible from another lock hopper and dosing system. The combustible dust of each lock hopper and dosing system is distributed evenly to the gasification burners through the respective supply lines. Providing a plurality of lock hopper and dosing systems offers the advantage that the burners will continue to operate steadily upon failure of one of them.

When each gasification burner is supplied through at least two supply lines, one supply line is led from each lock hopper and dosing system to each burner so that redundancy is provided in the event of a system failure.

The solution to the invention has the advantage that all the gasification burners are supplied uniformly and reliably with combustible dust. In this manner, it is possible to mix combustible dusts from diverse lock hopper and dosing systems of the large plants in the gasification burner.

Brief Description of the Drawings

The three following examples and the three Figures are intended to provide a better understanding of the invention. In said Figures:

Figure 1: shows an example in which each gasification burner is associated with one lock hopper and dosing system.

Figure 2: shows an example in which three gasification burners are associated with three lock hoppers and dosing systems, whereas each dust burner has one feed line from each of the three lock hoppers and dosing systems.

Figure 3: shows an example in which three gasification burners are associated with two lock hoppers and dosing systems, whereas each gasification burner has one feed line from each of the two lock hoppers and dosing systems.

Detailed Description of the Invention

Figure 1 shows an example in which each lock hopper and dosing system 1, 2, 3 is associated with one gasification burner 4, 5, 6. The objective is to feed a gasification reactor for entrained flow gasification of carbon dust with a gross input of 1,000 MW with the 180 Mg/h carbon dust needed for this purpose. For this purpose, there are arranged three lock hopper and dosing systems 1, 2, 3 (Fig. 1), each supplying a gasification burner 4, 5, 6 through the supply ports 4.1 through 6.3 thereof with 60 Mg/h combustible dust through three supply lines 1.1 through 3.3 with a feed capacity of 20 Mg/h. The capacity of each dust supply line 1.1 through 3.3. can be set in the range from 15-30 Mg/h. The three dust supply lines 1.1 through 3.3 of each lock hopper and dosing system 1, 2, 3 thereby end in a gasification burner 4, 5, 6 supplying it with the 60 Mg/h carbon dust mentioned. All the three lock hopper and dosing systems 1, 2, 3 must be in operation. Operation with two of the three gasification burners 4, 5, 6 results in unacceptable crooked burning in the gasification reactor. In the event of a failure of only one of the supply lines 1.1 through 3.3, the burner 4, 5, 6 of concern may also be operated for a limited time with two supply lines.

Figure 2 shows an example in which three lock hoppers and dosing systems 1, 2, 3 are associated with all three gasification burners 4, 5, 6. The objective is the same as in Figure 1. However, the three supply pipes 1.1 through 3.3 of each lock hopper and dosing system 1, 2, 3 are not connected to one gasification burner, but with all the three. Upon failure of one lock hopper and dosing system 1, 2, 3 each gasification burner 4, 5, 6 may also be supplied for a limited time from the two still operating lock hopper and dosing systems 1, 2, 3.

Figure 3 shows two lock hopper and dosing systems 1, 2 which are connected to three gasification burners 4, 5, 6. The objective is to supply a gasification reactor for entrained flow gasification of carbon dust having an output of 500 MW with the 90 Mg/h carbon dust needed for this purpose. For this purpose, two lock hopper and dosing systems 1,2 each having a capacity of 45 Mg/h, are arranged, each of the three supply lines 1.1 through 2.3 having an output of 15 Mg/h. Each gasification burner 4, 5, 6 is

supplied from two supply lines 1.1 through 2.3 originating from a respective one of the lock hopper and dosing systems 1, 2. As a result, two lock hopper and dosing systems 1, 2 can be utilized for middle-performance gasification reactors having three gasification burners 4, 5, 6.

CLAIMS:

1. An apparatus for gasifying combustible dusts comprising hard coal, lignite, petroleum coke, or solid grindable residues, and slurries, comprising:

an entrained gasification reactor for gasifying the combustible dusts at temperatures ranging from 1200 to 1900 degrees C and pressures of up to 80 bar;

wherein said gasification reactor comprises a plurality of gasification burners, each burner having an individual feed port;

wherein each gasification burner comprises a plurality of supply ports connected to said feed port;

a plurality of lock hopper and dosing systems arranged to supply dust or slurries to the gasification burners; and

a plurality of supply lines corresponding in number with said plurality of supply ports leading from each lock hopper and dosing system to said supply ports, and configured to provide dust or slurries to each feed port of every single burner.

2. The apparatus as set forth in claim 1, wherein a number of the plurality of lock hopper and dosing systems is fewer than the number of the plurality of gasification burners.

3. The apparatus as set forth in claim 2, wherein there are three gasification burners and two lock hopper and dosing systems.

4. The apparatus as set forth in claim 3, wherein each gasification burner is simultaneously supplied from two lock hopper and dosing systems through at least two supply lines, each of these two supply lines being associated with a different lock hopper and dosing system.

5. The apparatus as set forth in claim 1, wherein said plurality of lock hopper and dosing systems are configured to simultaneously supply dust or slurries to feed at least two of said plurality of gasification burners.

6. A reactor for the gasification of pulverized fuel from solid fuels such as bituminous coals, lignite coals, and their cokes, petroleum cokes, cokes from peat or biomass, in entrained flow, with an oxidizing medium containing free oxygen at temperatures between 1,200 and 1,900 degrees C and at pressures between atmospheric pressure and 80 bar, into a crude synthesis gas and slag, the reactor comprising:

a reactor head;

an ignition and pilot burner disposed at said head of the reactor;

a plurality of equal gasification burners disposed at said head of the reactor;

a plurality of lock hoppers and dosing systems arranged to supply said pulverized fuels to said plurality of equal gasification burners;

individual transport lines assigned to each gasification burner, said individual transport lines connecting and feeding said pulverized fuels from said lock hopper and dosing systems to the respective gasification burner;

wherein every single gasification burner is connected and fed by at least two different lock hoppers and dosing systems; and

a measuring system configured to measure and regulate amounts of pulverized fuel and oxygen flowing in each of said plurality of equal gasification burners, said measuring system controlling the overall total amounts of pulverized fuel and oxygen flowing in the reactor.

7. The reactor as in claim 6, wherein said plurality of equal gasification burners comprise at least three gasification burners and wherein said plurality of lock hoppers comprise at least three lock hoppers and dosing systems, wherein each gasification burner of said plurality of equal gasification burners is connected and fed with pulverized fuel over two burner individual transport lines with every single one of said three lock hoppers and dosing systems.

8. The reactor as in claim 6, wherein said plurality of equal gasification burners comprise three gasification burners and said plurality of lock hoppers and dosing systems comprise at least two lock hoppers and dosing systems, wherein each gasification burner is connected and fed with pulverized fuel over two burner individual transport lines with every single of said two lock hoppers and dosing systems.

9. The apparatus as in claim 4, wherein said plurality of lock hopper and dosing systems are configured and arranged such that the burners will continue to operate steadily upon failure of one of them, wherein each of said two lock hopper and dosing systems are coupled to each burner in a redundant manner so that redundancy is provided in the event of a system failure.

10. The reactor as in claim 6, wherein said plurality of lock hopper and dosing systems are configured and arranged such that the burners will continue to operate steadily upon failure of one of them, wherein each of said at least two lock hopper and dosing systems are coupled to each of said plurality of equal gasification burners in a redundant manner so that redundancy is provided in the event of a system failure.

11. The apparatus as in claim 1, wherein a plurality of the gasification burners are supplied uniformly with combustible dust.

12. The reactor as in claim 6, wherein a plurality of the gasification burners are supplied uniformly with combustible dust.

13. The apparatus as in claim 1, wherein all of the gasification burners are supplied uniformly with combustible dust.

14. The reactor as in claim 6, wherein all of the gasification burners are supplied uniformly with combustible dust.

15. The apparatus as in claim 1, wherein each of said plurality of gasification burners is coupled to said plurality of lock hopper and dosing systems such that said plurality of gasification burners are configured and arranged to prevent crooked burning in the gasification reactor.

16. The reactor as in claim 6, wherein each of said plurality of gasification burners is coupled to said plurality of lock hopper and dosing systems such that said plurality of gasification burners are configured and arranged to prevent crooked burning in the gasification reactor.

17. The apparatus as in claim 1, further comprising at least one metering system coupled to said entrained gasification reactor.

18. The apparatus as in claim 17, wherein said at least one metering system comprises at least one bunker, at least two pressurized sluices, and at least one metering tank, wherein an output of said metering system is coupled to said entrained gasification reactor.

19. The reactor as in claim 6, wherein said measuring system further comprises at least one bunker, at least two pressurized sluices, and at least one metering tank, wherein an output of said metering system is coupled to said entrained gasification reactor.

20. The reactor as in claim 19, further comprising at least one fluidizing gas line which leads into said at least one metering tank from below, and which provides for fluidizing the fuel.

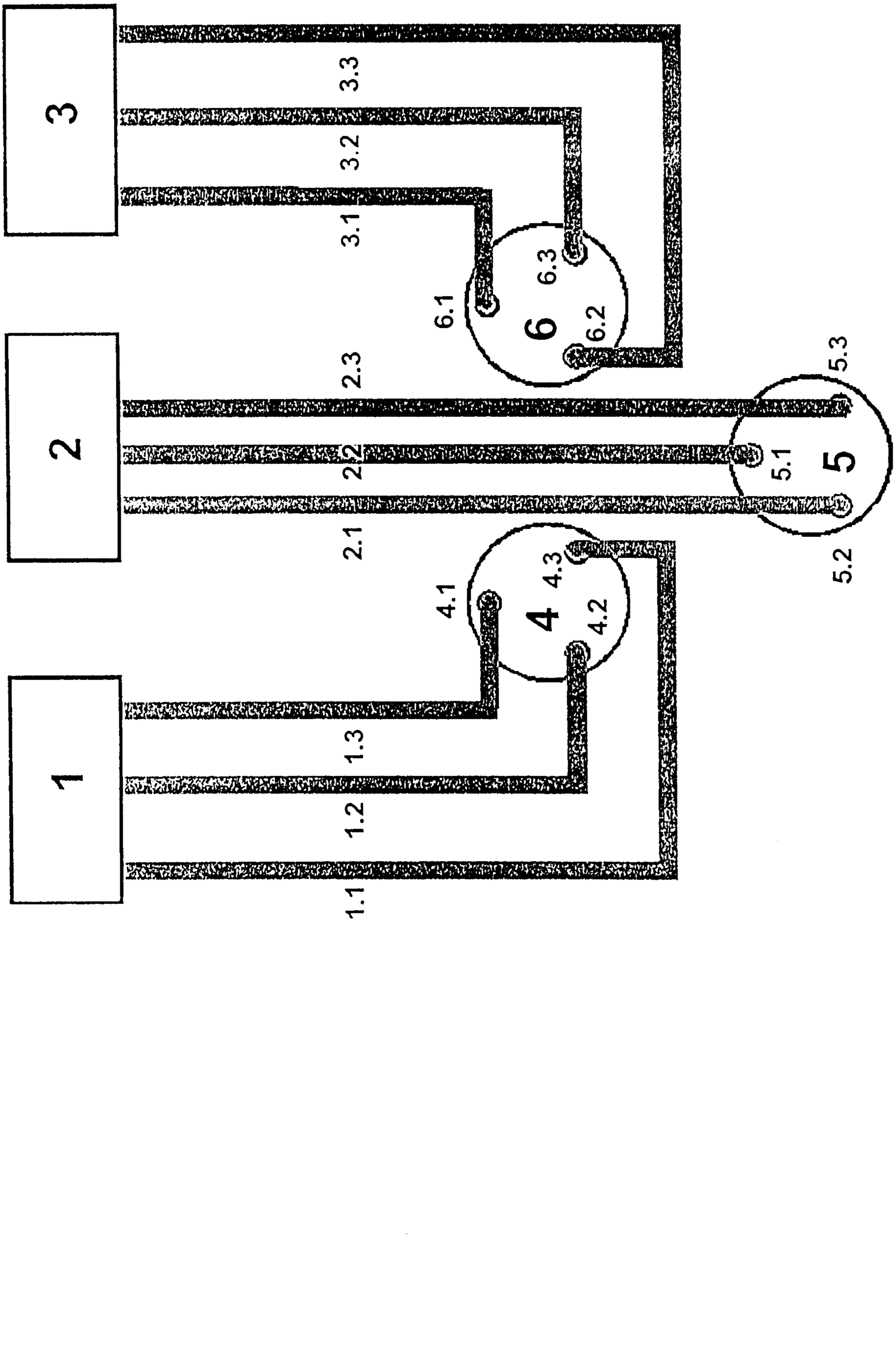


Fig. 1

Fig. 2

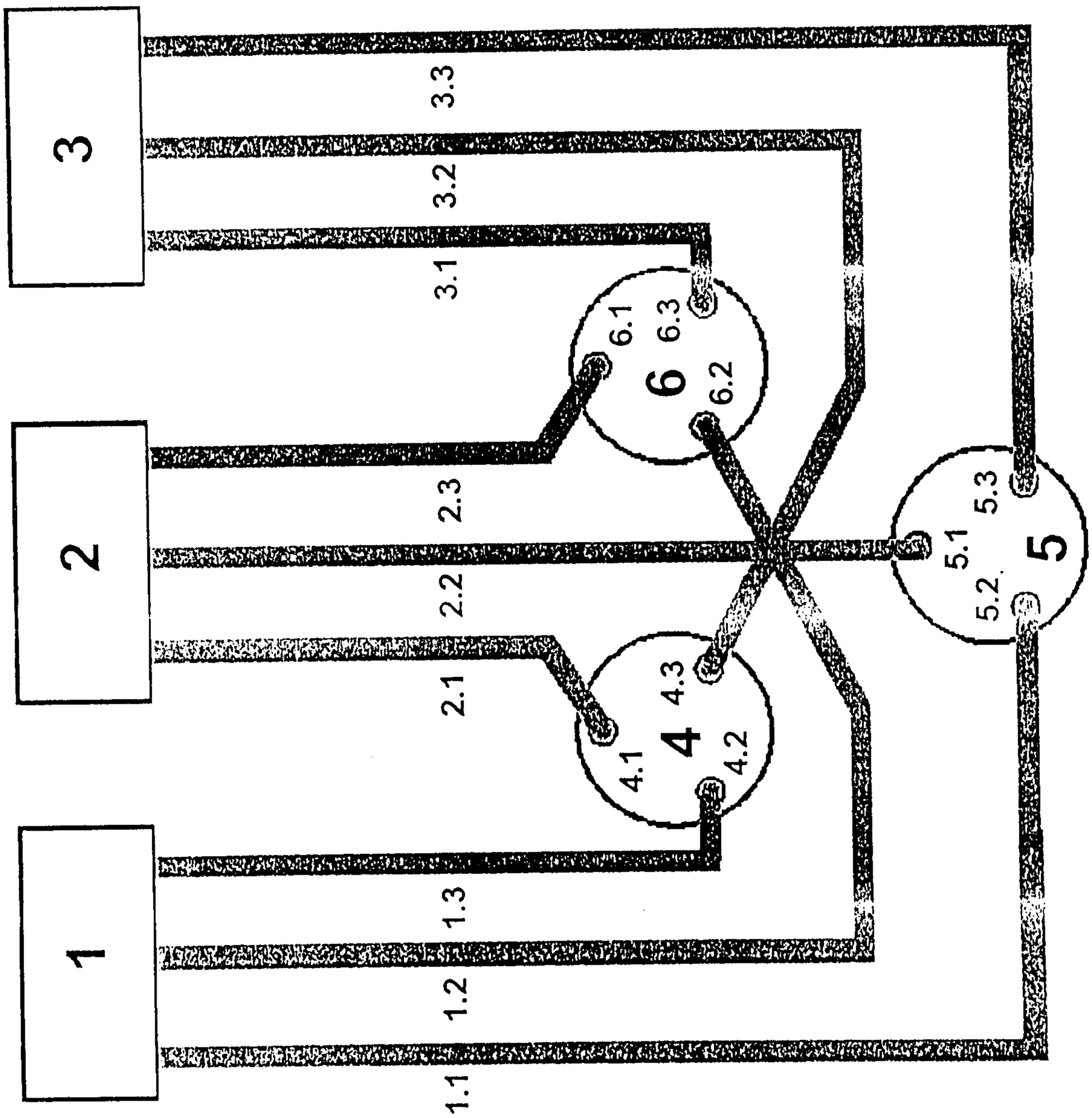
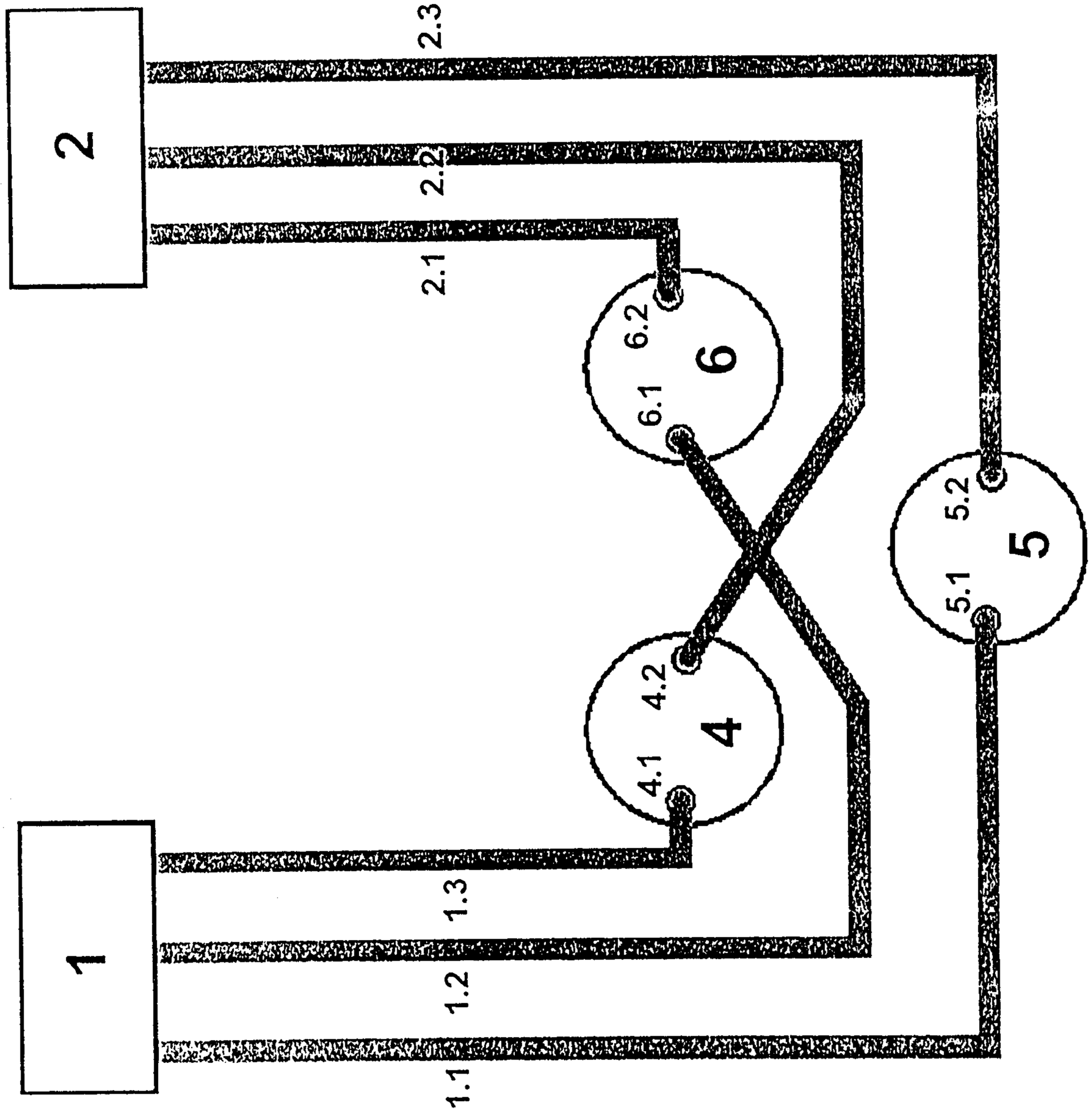
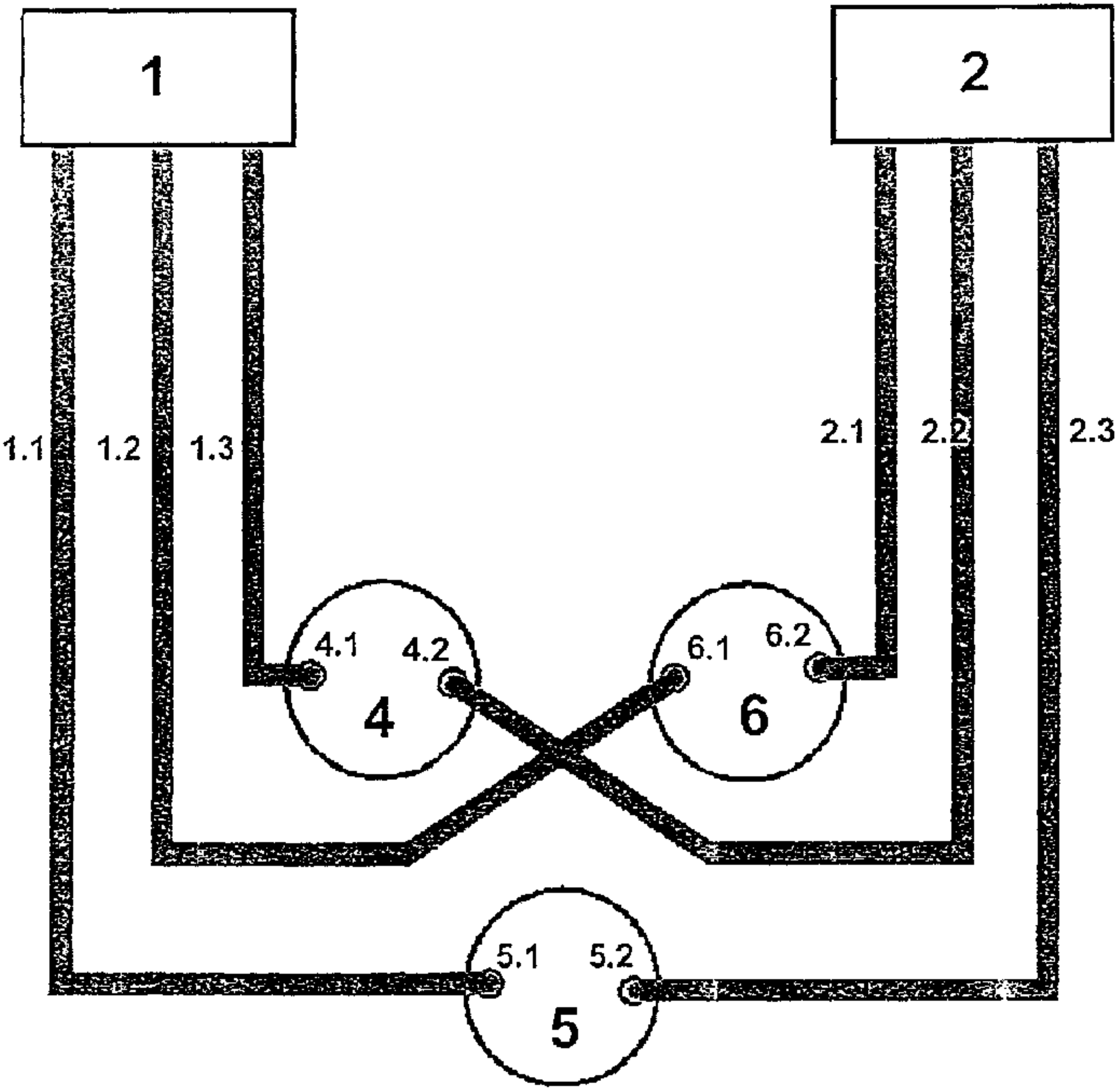


Fig. 3

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