METHOD AND SYSTEM FOR PRODUCING HOLES OF VARIOUS DIMENSIONS AND CONFIGURATIONS IN A WORKPIECE

Abstract: Method and system for producing holes of various dimensions and configurations in a workpiece (42) using a portable orbital drilling machine (44), wherein said workpiece has attached thereto a template (10) with preformed guide holes (12-40) located in a pattern corresponding to the positions of the holes to be formed in the workpiece. Each guide hole (12-40) is provided with a read-able information carrier (121-401) containing an identification of the respective guide hole. When fixing the drilling machine (44) in a guide hole, the latter is identified by a hole database (48) by sensing the respective information carrier. A control unit (50) associated with the hole database (48) controls the drilling machine (44) to perform a relevant hole-cutting process in the workpiece.
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FR, GB, GR, HU, IE, IS, IT, LT, LU, MC, NL, PL, PT, RO,
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GQ, GW, ML, MR, NE, SN, TD, TG).

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For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.
Method and system for producing holes of various dimensions and configurations in a workpiece

BACKGROUND OF THE INVENTION

1. Field of the invention

The present invention relates generally to a method of producing holes of various dimensions and configurations in a workpiece using a portable orbital drilling machine, said workpiece having attached thereto a template with preformed guide holes located in a pattern corresponding to the positions of the holes to be formed in the workpiece. The invention also relates a system for carrying out this method.

1. Description of related art

When producing a plurality of holes of various dimensions and configurations in a workpiece of composite material, such as fiber-reinforced composite materials, laminates, stacks of identical or various materials, etc., use of a portable orbital drilling machine is in many instances preferred, since all holes could normally be formed with one and the same cutting tool. In order to accurately locate the drilling machine to the position of the hole to be produced a template having preformed guide holes or bushings is fixated in a correct position to the workpiece. The drilling machine is then fixated successively to a respective guide hole or bushing in the template and is brought to perform an orbital cutting process relevant to the respective hole. Examples of such known hole-producing methods and devices are disclosed in WO 94/17944, WO 01/15870, and WO 02/102535. As many holes of various size and configurations are to be formed in a rapid sequence, the operator may have difficulties in identifying the guide hole and establishing which specific hole-cutting processing data should be applied by the drilling machine to the guide hole in question.
Summary of the invention

It is an object of the present invention to provide a method of producing holes of various dimensions and configurations in a workpiece using a portable orbital drilling machine, wherein said workpiece have attached thereto a template with pre-formed guide holes located in a pattern corresponding to the positions of the holes to be formed in the workpiece, which method obviates the risk of mixing-up hole-cutting processing data for the various holes to be formed in the workpiece and positively ensures a desired performance of the cutting tool of the drilling machine so as to obtain correctly formed holes. To this end, the method of the invention is characterized by the features set forth in claim 1.

It is a further object of the present invention to provide a system for safely carrying out the method. To this end, the system of the invention includes the features specified in the independent claim 3.

Further details and advantages of the method and system of the present invention will be apparent from the following detailed description and claims with reference to the accompanying drawings.

Brief description of the drawings

Fig. 1 is a plan view of a template having guide holes for attachment of an orbital drilling machine;

Fig. 2 is a schematic side elevational view of an orbital drilling machine fixated in a guide hole of a template; and

Fig. 3 is a sectional view of a workpiece having finished holes of various configurations.
Detailed description of a preferred embodiment

Fig. 1 shows a template 10 with a plurality of guide holes 12, 14, 16, 18, …, 40 located in a pattern corresponding to the positions of the holes to be formed in a workpiece 42 to which the template 10 is attached. Alternatively, guide bushings (not shown) inserted in the guide holes 12-40 of the template 10 may form guide holes for the fixation of a drilling machine 44 to the template 10. The drilling machine 44 has a rotary cutting tool 45 and a suitable fixation device for fixating the machine to the template 10, for example a fixation sleeve 46 having a slide fit with the guide holes 12-40. The workpiece 42 may consist of composite materials, such as fiber-reinforced composite materials, laminates, stacks of identical or various materials, etc. In order to produce flawless holes of various configurations and dimensions therein with help of one and the same cutting tool use of a portable orbital drilling machine 44 is preferred. As many holes of various size and configurations are to be formed in a rapid sequence, the operator may have difficulties in identifying the guide hole in which the machine 44 is fixated, and establishing which specific hole-cutting processing data should be applied by the drilling machine to the guide hole in question.

According to the invention a unique, individual marking or information carrier 12i – 40i containing an identification of the hole to be formed is affixed adjacent to each guide hole 12-40 on the template 10. The markings or information carriers 12i – 40i may consist of any suitable type of readable ID, such as a RFID tag or chip, a pin code, a color marking, etc., and can be identified by a reader or sensor 47 of the orbital drilling machine 44.

As shown schematically in Fig. 2, when attaching the drilling machine 44 to a guide hole 14 in the template 10, the sensor 47 will detect the hole identity of the adjacent information carrier 14i and transmit it to a hole database 48 containing all relevant information of the respective hole to be formed, such as type of hole, various proc-
essing and dimensional parameters thereof, e.g. diameter, depth and configuration of
the hole, cutting advancement speed, countersinks, etc. Then, a control unit 50 con-
5 nected, either by cables or wirelessly, to the hole database 48 and to the orbital drill-
ing machine 44 is adapted to control the machine to carry out the relevant hole cut-
ting process in the workpiece 42. Thus, the operator may only have to fixate the
drilling machine 44 in the guide holes 12-40 and to activate it to initiate the relevant
hole-cutting process.

Fig. 3 illustrates a workpiece in which various types of holes 52a-d have been pro-
10 duced by the same cutting tool 45 of the portable orbital drilling machine 44.

After the production of all holes in the workpiece a control measurement thereof
may be performed by means of a measuring probe to establish any discrepancies
from the predetermined parameters requiring renewed treatment of the hole in ques-
tion. The control unit 50 of the orbital drilling machine 44 may be connected to a
local network including a surveillance database (not shown) storing information re-
garding when and how the holes in the workpiece have been produced. Measure-
ment results of the drilled holes may be stored in the surveillance database. A sur-
veillance system may read the data from the surveillance database and may then be
used for checking whether the holes in the workpiece have been drilled in a correct
sequence, at the right time, with the correct parameters, by a correct cutting tool, etc.
Claims

1. Method of producing holes (52a-d) of various dimensions and configurations in a workpiece (42) using a portable orbital drilling machine (44), said workpiece (42) having attached thereto a template (10) with preformed guide holes (12-40) located in a pattern corresponding to the positions of the holes to be formed in the workpiece, characterized by the steps of:
   a) providing each guide hole (12-40) with a readable information carrier (12i-40i) containing an identification of the respective guide hole (12-40);
   b) identifying, when fixating the orbital drilling machine in a guide hole of the template, in which guide hole the drilling machine has been fixated by detecting the respective information carrier (12i-40i);
   c) transmitting the detected guide hole identification information to a hole database (48) containing relevant process and dimensional parameters of the hole to be formed in the workpiece by the drilling machine fixated in that guide hole;
   d) instructing, by means of a control unit (50) communicating with the hole database (48), the drilling machine (44) to perform in the workpiece a hole-cutting process relevant to the identified position of the drilling machine; and
   e) successively repeating the above-mentioned steps b) - d) to complete the forming of all holes.

2. Method of claim 1, characterized by the supplemental step of performing a control measurement of the produced holes (52a-d) to establish any discrepancies from the predetermined parameters.

3. System for producing holes (52a-d) of various dimensions and configurations in a workpiece (42), comprising a portable orbital drilling machine (44) having a rotary cutting tool (45) and configured to be detachably fixated in preformed guide holes (12-40) of a template (10) which is attached to the workpiece (42) such that the guide holes of the template are located in a pattern corresponding to the positions of
the holes (52a-d) to be formed in the workpiece, characterized in that the system comprises an individual, readable information carrier (12i-40i) containing a relevant hole identification, assigned and attached adjacent to each of the guide holes (12-40) of the template (10); a sensor (47) mounted to the drilling machine (44) and configured, when fixating the drilling machine in a guide hole of the template, to detect the information carrier (12i-40i) of the respective guide hole (12-40) and to transmit the relevant information thereof to a hole database (48); and a control unit (50) configured to receive from the hole database (48) hole-processing data relevant to the hole to be formed, and configured to instruct the drilling machine (44) to carry out the relevant hole-cutting process in the workpiece (42) to form a predetermined hole (52a-d) in the workpiece accordingly.

4. System of claim 3, characterized in that the readable information carrier (12i-40i) includes of a RFID chip.

5. System of claim 3, characterized in that the readable information carrier includes a pin code tag.

6. System of claim 3, characterized in that the readable information carrier includes a color mark.

7. System of anyone of claims 3-6, characterized in that the sensor (47) includes an antenna configured to detect the information carrier (12i-40i) without contacting the same.

8. System of claim 7, characterized in that the sensor (47) is configured to transmit the detected relevant hole identification to the hole database (48) through a wireless connection.
9. System of anyone of claims 3-8, characterized in that the control unit (50) is integrated in the drilling machine (44).

10. System of anyone of claims 3-8, characterized in that the control unit (50) is an external unit connected to the drilling machine (44) through a cable arrangement.
### INTERNATIONAL SEARCH REPORT

**International application No.**

**PCT/SE 2005/000873**

### A. CLASSIFICATION OF SUBJECT MATTER

**IPC7:** B23B 35/00, B23Q 9/00

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

### B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

**IPC7:** B23B, B23C, B23Q

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

SE, DK, FI, NO classes as above

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

**EPO-INTERNAL, WPI DATA, PAJ**

### C. DOCUMENTS CONSIDERED TO BE RELEVANT

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*Further documents are listed in the continuation of Box C.*

*See patent family annex.*

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