System of laser positioning of an aperture processing machine

Laser-Positionier-System für Maschine zum Bearbeiten von Löchern
Système de positionnement par laser pour machine pour l’usinage de trous

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(73) Proprietor: Qingdao D&D Electro Mechanical Technologies Co., Ltd.
Laoshan District
Qingdao City
Shandong 266071 (CN)

(72) Inventors:
• Zhang, Yongsheng
South District,
Qingdao (CN)
• Jianjin, Guo
Qingdao 266071 (CN)

(74) Representative: Rupp, Christian
Mitscherlich & Partner
Patent- und Rechtsanwälte
Sonnenstrasse 33
80331 München (DE)

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Description

BACKGROUND OF THE INVENTION

Field of The Invention

[0001] The present invention relates to an aperture-processing machine according to the preamble of claim 1, and in particular, a system of laser positioning in the aperture-processing machine used for locating the position of the aperture that is being processed on a work piece accurately. Such a machine is known from document US 5 741 096 A.

Description of the Prior Art

[0002] At present, when aperture-processing machines such as the drilling machine and lathe are used for aperture processing, in general, lines have to be drawn on the work piece to be processed beforehand. A centre bore is then made with a piercing mandrel before the aperture-processing machine is switched on for test drilling. Based on the result of test drill, the position of the work piece being processed is adjusted. This is repeated a number of times until the test drilled hole and the position of the centre bore are aligned before aperture processing is formally carried out. In the process, test drilling and adjustment of the position of the work piece being processed are usually repeated many times before an aperture with an acceptable position can be finalised. The adjustment is labour and time-consuming and easily leads to eye fatigue for the operating worker. Besides, it is difficult to guarantee the precision of the position of the aperture.

[0003] An optical pointing device for mechanical machining operations is known from DE 33 33 428 A1. The device comprises two light spot projectors producing two intersecting lines. The projectors are mounted on hanging arms laterally of the working area with their axes inclined at 45°. This arrangement occupies much space and complicates operation as well as adjustment of the projectors.

[0004] A line-laser assisted alignment apparatus is known from US 5,741,096, projecting two intersecting fan beams. The laser guns are mounted on a semicircular platform arranged below the reference plane. The beams are projected from below at an inclined angle.

SUMMARY OF THE INVENTION

[0005] In order to overcome the existing technological shortcoming mentioned above, the present invention provides a type of main bearing cutter centre of the aperture-processing machine that is capable of accurately marking on the work piece being processed. The work piece to be processed can be moved easily so that the centre of the aperture to be processed coincides with the cutter centre. Positioning is accomplished rapidly with a high precision and efficiency. Besides, it is a laser positioning in an aperture-processing machine that can effectively reduce eye fatigue of the operating worker.

[0006] To achieve the above-mentioned objective, the solution provided by the present invention is an aperture-processing machine according to claim 1 which includes two laser-transmitting devices, each of which transmits a light beam. The two light beams become an angular set up. The point of their intersection in space forms a common line of intersection. After both laser-transmitting devices are fixed relative to the aperture-processing machine, the common line of intersection formed at the point of intersection of the two light beams mentioned above coincides precisely with the axial line of the cutter centre of the aperture-processing machine, forming the reference for positioning.

[0007] In the present invention, the light beams transmitted by the laser transmission devices mentioned above are planar. The relative vertical projection of the said planar beams is a fine, straight line. Therefore, the two planar beams should be very thin planes. When these two very thin planar beams intersect, the common line of intersection will also be a very fine, straight line. When the surface of the work piece intersects the said straight line, the projection is a very small light dot. As the said common line of intersection coincides with the axial line of the cutter, squaring operation is achieved merely by aligning the position of the centre bore of the work piece with the said light dot. Therefore, by using the system of laser positioning of the present invention, it will not be necessary to repeat test drilling several times when carrying out aperture processing. The processing is done after direct alignment.

[0008] The two laser-transmitting devices are fixed on the spindle box of the aperture-processing machine, preferably with their transmission ends facing the side of the main bearing cutter. The two planar light beams produced by them are found within the space where the main bearing cutter is situated.

[0009] The said spindle box can be fixed with a chassis relative to the main axial symmetry. The laser transmitting devices are installed on the chassis.

[0010] There are holes on the fixed chassis. The laser transmission devices are installed in the holes on the fixed chassis. There are female threads or male threads at their tail end. A regulatory screw with corresponding male threads or female threads and protruded shoulder is fixed in the female or male threads. The regulatory screw and the laser transmission devices are clamped on the fixed chassis with the help of the screw threads.

[0011] The laser transmission devices mentioned in the present invention may be pen-shaped. Usually it is possible to use a conventional pen-shaped laser transmitter. However, as the light beam generated by a conventional pen-shaped laser transmitter is usually a cylindrical beam, in the present invention, when the conventional laser transmitter that is capable of generating a cylindrical beam is used, a beam expander is installed.
at the transmission end of the laser transmitter. Through this beam expander, the cylindrical beam is expanded into a planar beam. This constitutes the laser transmission device mentioned in the present invention.

[0012] For example, the pen-shaped laser transmission device mentioned in the may include a semiconductor-laser-diode type laser transmitter. Near the transmitting end of this semiconductor-laser-diode type laser transmitter, a beam expander is installed. This beam expander expands the cylindrical laser beam given out by the semiconductor-laser-diode type laser transmitter and the pen-shaped laser transmission device emits a planar beam from its transmission end.

[0013] The said beam expander is composed of a convex lens and a cylindrical lens. The convex lens and the cylindrical lens are set up along the line of axis of the cylindrical laser beam mentioned. The beam expander may also be composed of a convex lens and a corrugated lens. The convex lens and the corrugated lens are set up along the line of axis of the cylindrical laser beam mentioned or other forms of beam expander may be used to achieve the performance set by the present invention. Besides, this laser transmitter can be other forms of laser transmitters.

[0014] When installing the present invention, it is necessary to adjust the position of installation of the two laser transmission devices. Firstly, the two planar beams generated by them must be able to form an angular set up to guarantee the production of a common line of intersection when they intersect in the space. The angle of the laser transmission device is further adjusted to finally bring about precise coincidence of the common line of intersection of the two planar beams and the main bearing cutter centre of the aperture-processing machine. Therefore, the position of the aperture being processed can be accurately determined with high precision and rapidity. The problem of several times of adjustment and testing is resolved.

[0015] In a preferred embodiment of the present invention, there are holes on the fixed chassis for installing the laser transmission device. The laser transmission device is pen-shaped, with female or male threads at its tail end. A regulatory screw with corresponding male threads or female threads and protruded shoulder is fixed in the female or male threads. The regulatory screw and the tail end of the laser transmission devices are clamped on the fixed chassis with the help of the screw threads.

[0016] Adjusting the laser transmission device can be achieved as follows: When the regulatory screw is loosened, the laser transmission devices can be made to revolve on the fixed chassis together with the regulatory screw until the line of intersection produced by the intersecting fine, straight-line light beams from both the left and right laser transmission devices coincides precisely with the main bearing cutter centre of the aperture-processing machine. The laser transmission devices are then fixed by hand until they stop moving. The regulatory screw is then turned tight. Upon completion of adjustment, the intersecting line that is in precise coincidence with the main bearing cutter centre is perpendicular to the operating platform. Regardless of the height of the work piece, the centre marked on the work piece will always be the cutter centre. Processing can be done clearly and precisely. Based on the theory of adjustment of the present invention, it is also possible to use other regulatory structures and not restricted to the use of a regulatory screw of the present invention.

[0017] The present invention has the advantages of rapidity, accuracy, low cost and ease of use. It can be used widely in processing machines such as drilling machines, lathes and boring lathes.

BRIEF DESCRIPTION OF THE DRAWINGS

[0018] Figure 1 is a schematic view showing the machine of the present invention.

Figure 2 is the lateral view of Figure 1 in accordance with the present invention.

Figure 3 is a schematic view showing the principle of operation in accordance with the present invention.

Figure 4 is a schematic view showing the structure of the present invention.

Figure 5 is a schematic view showing the optical theory of the present invention.

Figure 6 is a schematic diagram showing the laser transmission device in accordance with the present invention.

Figure 7 is a schematic view showing another preferred embodiment of a laser transmission device in accordance with the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

Preferred embodiment 1

[0019] The present invention is an aperture processing machine having a type of system of laser positioning. As shown in Figure 5, there are two laser transmission devices (2). Each laser transmission device (2) emits a light beam (13). The two light beams (13) form an angular set up. Their point of intersection in space forms a common line of intersection (8). After both laser transmitting devices (2) are fixed relative to the aperture-processing machine, the common line of intersection (8) formed at the point of intersection of the two light beams (13) mentioned above coincides exactly with the axial line of the cutter centre of the aperture-processing machine, forming the point of reference for positioning.

[0020] In the present invention, the light beams (13) transmitted by the laser transmission devices (2) mentioned above are planar. The relative vertical projection of the said planar beam (13) is a fine, straight line (9).
Therefore, the two planar beams (13) should be a very thin plane. When these two very thin planar beams (13) intersect, the common line of intersection (8) will also be a very fine, straight line. When the surface of the work piece intersects the said straight line, the projection is a very small light dot (14). As the said common line of intersection (8) coincides with the axial line of the cutter, squaring operation is achieved merely by aligning the position of the centre bore of the work piece with the said light dot (14). Therefore, by using the system of laser positioning of the present invention, it will not be necessary to repeat test drilling several times when carrying out aperture processing. The processing is done after direct alignment. As the above-mentioned light point (14) is situated at an arbitrary height on the common line of intersection (8), the present invention is applicable to a work piece at an arbitrary height.

[0021] As shown in Figure 1 and Figure 2, the present invention should be installed relative to the aperture-processing machine. In the present preferred embodiment, the aperture-processing machine is a type of drill machine. The system of positioning in the present invention can be fixed and linked to a spindle box (3). In the present preferred embodiment, two fixed chassises (1) can be installed on the spindle box (3) relative to the main axis symmetry. The laser transmission devices in the present invention are installed on the said fixed chassises (1). When using the present invention, the regulatory screw (6) is loosened. The laser transmission device (2) is further adjusted along its axial line, thus adjusting the direction and position of the two planar light beams.

[0024] The theory of the present invention is shown in Figure 3. The light planes emitted by the laser transmission devices (2), that is, the position of installation of the axial plane along its axial line has an angle of intersection. The devices are located above the working platform (4) of the aperture-processing machine. The two light planes intersect the operating platform, forming a fine, straight-line laser light (9) respectively. The two fine, straight-line laser light (9) have a light spot of intersection on the operating platform. The light spot is on the 0 spot on the central line of the main bearing cutter. This is also the centre of the hole to be processed on the work piece.

[0025] As shown in Figure 6, in the present preferred embodiment, a type of laser transmission equipment (10) made of a semiconductor laser diode tube is used. It is able to transmit an extremely fine, cylindrical beam of light (15). On the same axis as the cylindrical light beam (15), a beam expander is installed. In the present preferred embodiment, the beam expander mentioned is composed of a convex lens (11) and a cylindrical lens (12). The convex (11) lens and cylindrical lens (12) are installed along the axial line of the cylindrical laser beam mentioned above. After penetrating the set of beam expander, the said cylindrical light beam (15) is expanded to become a planar light beam (13) for emission.

[0026] When using the present invention, the regulatory screw (6) is loosened. The laser transmission devices can be made to revolve on the fixed chassis together with the regulatory screw (6) until the common line of intersection (8) of the planar light beams emitted by both the left and right laser transmission devices (13) coincides precisely with the central line of the main bearing cutter of the aperture-processing machine. The laser transmission devices are then fixed by hand until they stop moving. The regulatory screw is then turned tight. Regardless of the height of the work piece, the centre of the aperture to be drilled marked on the work piece will always be on the central line of the cutter. It is obvious and accurate during processing.

[0027] In the present preferred embodiment, it is also possible to achieve the regulation of position of the plane of the light beams (13) by adjusting the angle of the cylindrical lens (12) and the cylindrical laser beam (15), thus adjusting the common line of intersection (8) of the light beam planes and the axial line of the main bearing cutter of the said aperture-processing machine so that they coincide exactly, forming the point of reference for positioning.

[0028] In the present preferred embodiment, the aperture-processing machine can be a boring lathe.

[0029] In the course of application of the present invention, adjustment is easy, positioning is rapid and observation is direct with high accuracy and low cost. It can be used widely in processing machines such as drilling...
machines, boring lathes and lathes.

Preferred embodiment 2

[0030] As shown in Figure 7, the difference between the present example and the above-mentioned example lies in the fact that the said laser transmission device (2) can be composed of a semiconductor-laser-diode-type laser transmitter (10) and beam expander. The beam expander can be composed of a convex lens (11) and a corrugated lens (16). The convex lens (11) and the corrugated lens (16) are set up along the axial line of the cylindrical laser beam mentioned. The semiconductor-laser-diode-type laser transmitter (10) can emit an extremely fine cylindrical beam (15). After penetrating through the said beam expander, this cylindrical beam (15) is expanded to become a planar light beam (13) and emitted.

[0031] In the present preferred embodiment, it is possible to adjust the position of the planar light beam (13) by the way described in the preferred embodiment 1. The adjustment of position of the plane of the light beam (13) can also be achieved through the regulation of the angle of the corrugated lens (16) and the cylindrical laser light beam (15), thus adjusting the common line of intersection (8) of the light beam planes and the axial line of the main bearing cutter of the said aperture-processing machine so that they coincide exactly, forming the point of reference for positioning.

[0032] The basic structure, principle and effects of the present preferred embodiment are the same as those for application example 1 and will not be repeated here.

[0033] It is not intended to limit the present invention only to the preferred embodiments illustrated and described. Rather, the scope of the invention is to be determined by the appended claims.

Claims

1. An aperture-processing machine which includes a system of laser positioning, comprising

   - two laser transmission devices (2), whereby the laser transmission devices (2) are fixed with respect to the aperture processing machine,
   - whereby each laser transmission device (2) is capable of transmitting a planar light beam (13) which is perpendicular to a working platform (4), whereby the two planar light beams (13) are formed into an angle, and are forming a common line (8) intersected in space, and are projected on the working platform (4) into two lines (9) with a point of intersection, whereby the point of intersection forms a reference for positioning, and
   - means for adjusting the common line of intersection (8) in such a manner that it coincides precisely with the axial line of the main bearing cutter of the aperture-processing machine, characterized in that
     - the two laser transmission devices (2) are fixed to a spindle box (3) of the aperture processing machine,
     - the transmitting ends of the two laser transmission devices (2) and the main bearing cutter are located above the working platform (4), and
     - the central lines of the two laser transmission devices (2) are perpendicular to the plane of the working platform (4) and parallel to the axial line of the main bearing cutter of the aperture processing machine.

2. The aperture-processing machine as claimed in claim 1, characterized in that said spindle box (3) has two fixed chassises (12) relative to the spindle symmetrically, the center of the hole for installation being parallel with the center of the spindle, said laser transmission devices (2) are installed on the fixed chassises (1) respectively.

3. The aperture-processing machine as claimed in claim 2, characterized in that there are holes on the fixed chassis (12) and the laser transmission devices (2) are installed in the holes of the fixed chassises (1) and have female threads or male threads on their tails and regulatory screws corresponding to the male threads or female threads (7), and a protruded shoulder is installed within the female or male thread, and the regulatory screw (6) and the laser transmission devices (2) are clamped onto the fixed chassises (1) by means of threads.

4. The aperture-processing machine as claimed in claim 1, characterized in that the laser transmission devices (2) are pen-shaped.

5. The aperture-processing machine as claimed in claim 4, characterized in that the laser transmission device (2) includes at least a laser transmitter (10) near the transmitting end of which a beam expander is installed and the beam expander expands the fine cylindrical laser beam (15) produced by the laser transmitter and a planar beam (13) is emitted from the transmitting end of the pen-shaped laser transmission device.
Patentansprüche

1. Lochbearbeitungs-Maschine, welche ein System zur Laser-Positionierung enthält, aufweisend

- zwei Laser aussendende Einheiten (2) wobei die Laser aussendenden Einheiten (2) bezüglich der Lochbearbeitungs-Maschine festgelegt sind, wobei jede Laser aussendende Einheit (2) in der Lage ist, einen planaren Lichtstrahl (13) auszusenden, welcher senkrecht auf einer Arbeitsplattform (4) steht, wobei die beiden planaren Lichtstrahlen (13) einen Winkel einschließen und eine einfache Schnittlinie (8) im Raum bilden und auf die Arbeitsplattform (4) projiziert werden, wo sie zwei Linien (9) mit einem Schnittpunkt bilden, wobei der Schnittpunkt eine Referenz zur Positionierung darstellt sowie
- Elemente, um die Schnittlinie (8) in einer Weise zu justieren, dass diese exakt mit der axialen Linie des Hauptbohrfutters der Lochbearbeitungs-Maschine zusammenfällt dadurch gekennzeichnet, dass

- die beiden Laser aussendenden Einheiten (2) an einem Spindelgehäuse (3) der Lochbearbeitungs-Maschine befestigt sind,
- die strahlenden Enden der beiden Laser aussendenden Einheiten (2) und das Hauptbohrfutter über der Arbeitsplattform (4) angebracht sind und
dadurch gekennzeichnet, dass
die Zentrallinien der beiden Laser aussendenden Einheiten (2) zur Ebene der Arbeitsplattform senkrecht sind und zur axialen Linie des Hauptbohrfutters der Lochbearbeitungs-Maschine parallel sind.

2. Lochbearbeitungs-Maschine nach Anspruch 1, dadurch gekennzeichnet, dass das Spindelgehäuse (3) zwei feste Aufnahmen (1) aufweist, die bezüglich der Spindel symmetrisch sind, wobei die Mitte des für die Installation vorgesehenen Loches parallel ist zur Mitte der Spindel, wobei die Laser aussendenden Einheiten (2) jeweils an den festen Aufnahmen installiert sind.


4. Lochbearbeit-Maschine nach Anspruch 1, dadurch gekennzeichnet, dass die Laser aussendenden Einheiten (2) stiftförmig sind.

5. Lochverarbeitende Maschine nach Anspruch 4, dadurch gekennzeichnet, dass die Laser aussendende Einheit (2) mindestens einen Laser Sender enthält (10), wobei nahe dessen strahlenden Endes ein Strahlaufweiter angebracht ist, wobei dieser den dünnen, zylindrischen Laserstrahl (5), den der Laser Sender produziert aufweitet, wobei ein planer Strahl (13) vom strahlenden Ende der stiftförmigen, Laser aussendenden Einheit emittiert wird.

Revendications

1. Machine de réalisation d’ouvertures qui comprend un système de positionnement au laser, comprenant deux dispositifs d’émission laser (2), grâce à quoi les dispositifs d’émission laser (2) sont fixés par rapport à la machine de réalisation d’ouvertures, grâce à quoi chaque dispositif d’émission laser (2) peut émettre un faisceau lumineux plan (13) qui est perpendiculaire à une plate-forme de travail (4), grâce à quoi les deux faisceaux lumineux plans (13) sont formés suivant un angle et forment un axe commun (8) d’intersection dans l’espace, et sont projetés sur la plate-forme de travail (4) sous la forme de deux axes (9) ayant un point d’intersection, grâce à quoi le point d’intersection forme une référence de positionnement, et un moyen d’ajustement de l’axe commun d’intersection (8) de telle manière qu’il coïncide précisément avec la ligne axiale du dispositif de coupe de support principal de la machine de réalisation d’ouvertures, caractérisée en ce que

les deux dispositifs d’émission laser (2) sont fixés à une boîte à broches (3) de la machine de réalisation d’ouvertures, les extrémités d’émission des deux dispositifs d’émission laser (2) et le dispositif de coupe du support principal sont situés au-dessus de la plate-forme de travail (4), et les lignes médiennes des deux dispositifs d’émission laser (2) sont perpendiculaires au plan de la plate-forme de travail (4) et parallèles à la ligne axiale du dispositif de coupe de support principal de la machine de réalisation d’ouvertures.

2. Machine de réalisation d’ouvertures selon la revendication 1, caractérisée en ce que ladite boîte à broches (3) comporte deux châssis fixes (1) par rapport à la bro-
che de façon symétrique, le centre du trou pour l’installation étant parallèle au centre de la broche, lesdits dispositifs d’émission laser (2) sont installés sur les châssis fixes (1) respectivement.

3. Machine de réalisation d’ouvertures selon la révélation 2, caractérisée en ce que il existe des trous sur le châssis fixe (12) et les dispositifs d’émission laser (2) sont installés dans les trous des châssis fixes (1) et comportent des filets femelles ou des filets mâles sur leurs extrémités et des vis de réglage correspondant aux filets mâles ou aux filets femelles (7), et un épaulement protubérant est installé à l’intérieur du filet femelle ou mâle, et la vis de réglage (6) et les dispositifs d’émission laser (2) sont serrés sur les châssis fixes (1) au moyen de filets.

4. Machine de réalisation d’ouvertures selon la révélation 1, caractérisée en ce que les dispositifs d’émission laser (2) sont en forme de stylo.

5. Machine de réalisation d’ouvertures selon la révélation 4, caractérisée en ce que le dispositif d’émission laser (2) comprend au moins un émetteur laser (10), près de l’extrémité d’émission duquel un expander de faisceau est installé, et l’expanser de faisceau dilate le faisceau laser cylindrique mince (15) produit par l’émetteur laser et un faisceau plan (13) est émis à partir de l’extrémité d’émission du dispositif d’émission laser en forme de stylo.