United States Patent [19]

Anefall

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[54] **METHOD OF PUNCHING SHEET SEGMENTS HAVING SUBSTANTIALLY ANNULAR SECTOR SHAPE**

[75] Inventor: **Gunnar Anefall,** Vasteras, Sweden

[73] Assignee: **Allmanna Svenska Elektriska Aktiebolaget,** Vasteras, Sweden

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[52] **U.S. Cl.** **83/50,** 83/34, 83/36, 83/424, 83/559, 83/649

[51] **Int. Cl.** **B26f 1/40**

[58] **Field of Search** 83/50, 43, 48, 34, 36, 83/424, 559, 649

[56] **References Cited**

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Primary Examiner—Frank T. Yost

[57] **ABSTRACT**

For punching sheet segments having substantially annular sector shape, with two radially directed sides, a sheet metal strip of constant width is fed through a punching device which punches out the segments of the desired shape one by one. The sheet metal strip has a width which is more than the air gap radius but less than twice the maximum outer radius of the core. The punching tool is punched in such a way that the cutting edge which forms one of the radially directed sides is parallel to and close to one longitudinal edge of the strip. The unpunched portion of the strip is coiled on a winder-recoiler. After the strip has been fed through in one direction, the position of the strip with respect to the punch (or vice versa) is reversed, and the strip is fed in the other direction through the punch, which punches out similar shaped pieces from the remaining portion of the strip.

4 Claims, 6 Drawing Figures

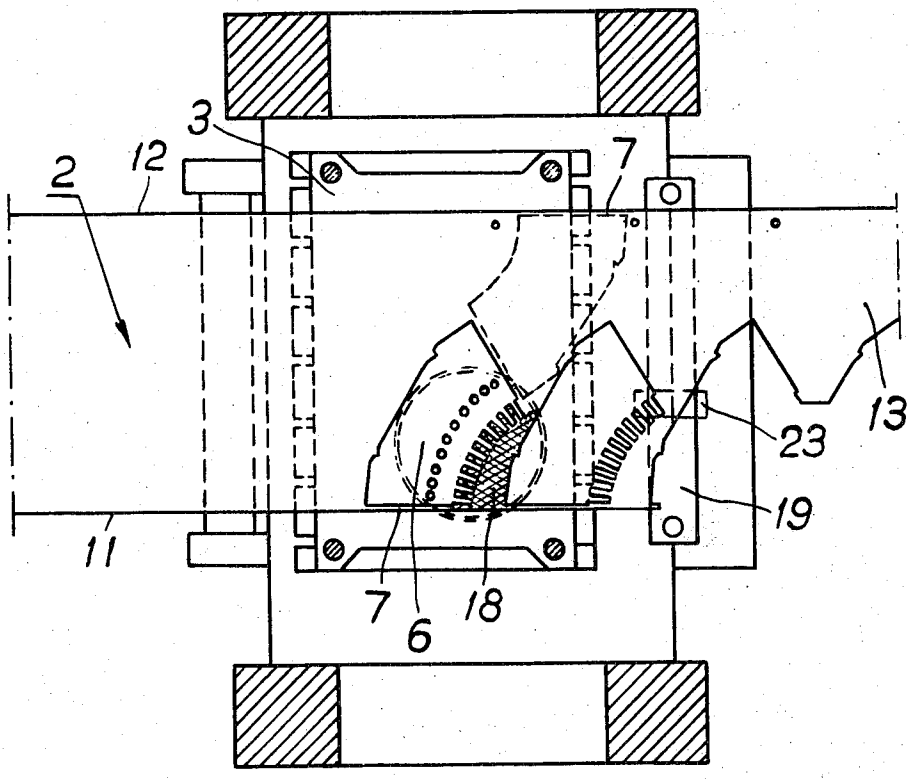


Fig.1

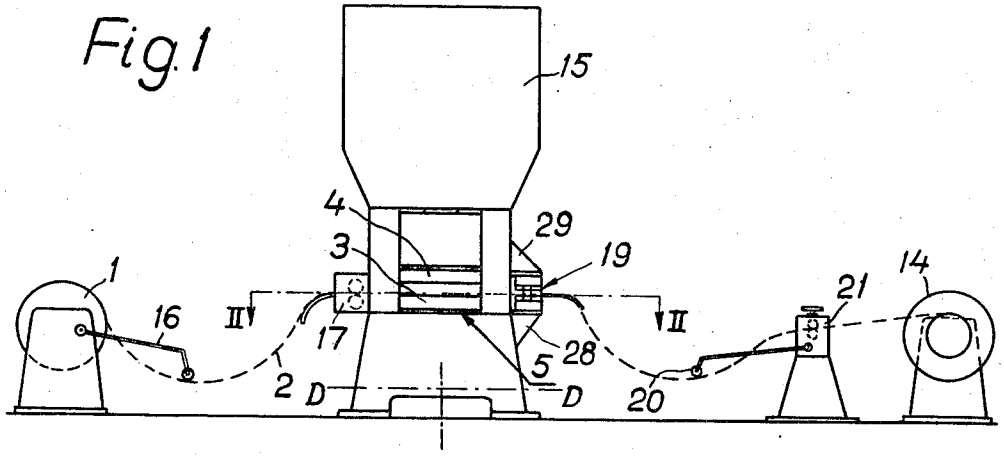


Fig.2

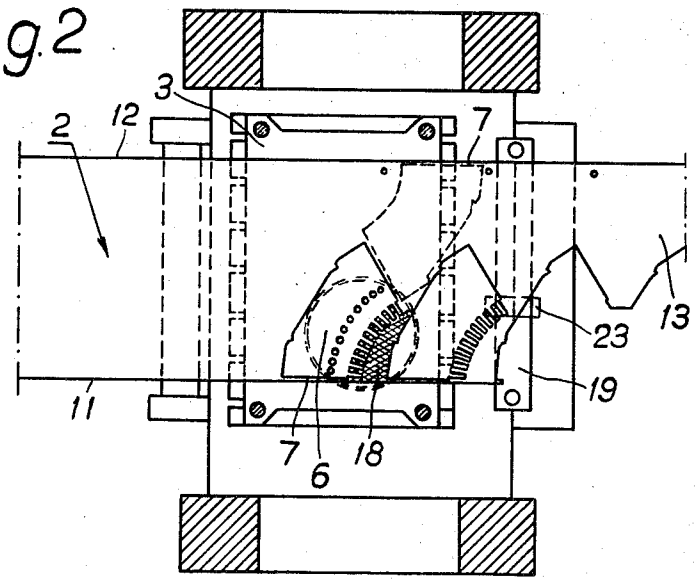


Fig.3

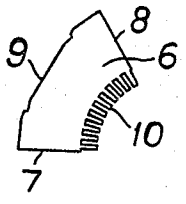


Fig. 4

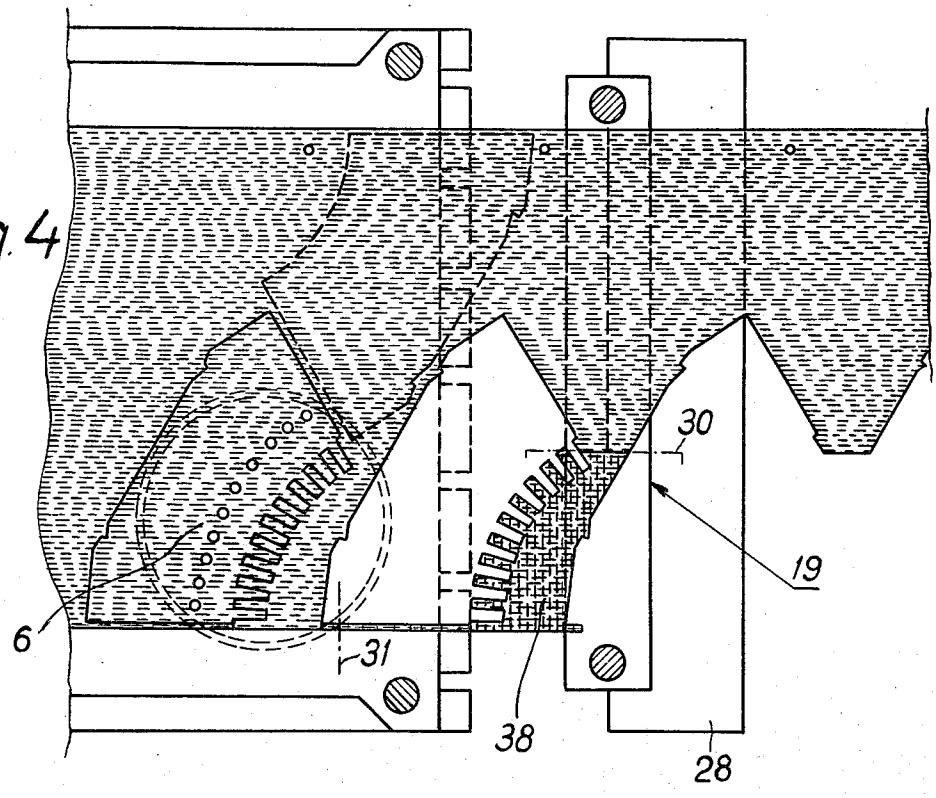


Fig. 5

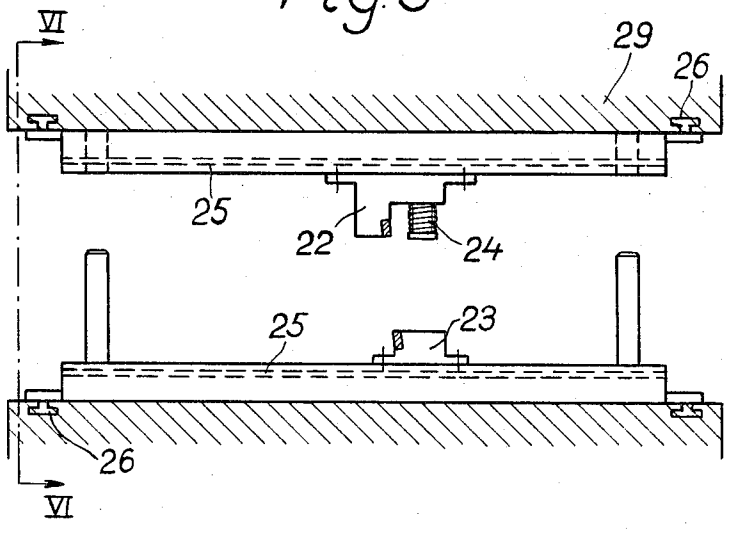
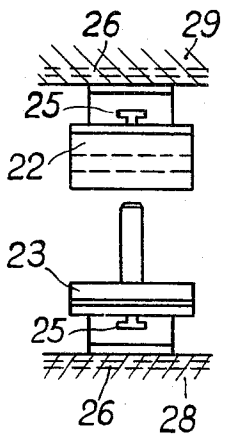


Fig. 6



METHOD OF PUNCHING SHEET SEGMENTS HAVING SUBSTANTIALLY ANNULAR SECTOR SHAPE

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present patent application relates to a method of punching sheet segments having substantially annular sector shape, intended to form the stator core in a turbo-generator, each segment lying within a sector angle of 40° – 80° and being limited by a back side, a slot side and two radially oriented sides, said method comprising feeding a sheet metal strip of constant width from a winder-recoiler between the lower part and the upper part of a punching tool, the working profile of which corresponds to the shape of said sheet segments, and individual punching out of a plurality of sheet segments by means of said tool.

2. The Prior Art

When punching such sheet segments it is known to use as material a sheet metal strip, the width of which is equal to the greatest linear dimension of the sheet segment, each segment being punched out in such a way that the chord over the air-gap arc forms a **90°** angle with the longitudinal direction of the strip.

SUMMARY OF THE INVENTION

The purpose of a method according to the invention is to achieve a punching which is well adapted for automatization and which gives a better utilization of the material. Furthermore it is desirable, in about the same degree as in the above-mentioned known method, to achieve a favorable orientation of the segments in relation to the rolling direction, that is, it is desirable that the tooth projections to the greatest possible extent coincide with the direction of the rolling.

According to the invention, sheet segments having substantially annular sector shape, intended to form a steel core in a turbo-generator, and which have a back side, a slot side and two radially oriented sides, are produced by feeding sheet metal strips of constant width from a winder-recoiler through a punching tool. The tool has the profile of the sheet segments which are to be punched out. The sheet metal strip has a width which is more than the air gap radius and less than twice the maximum outer radius of the stator core. The punching tool is positioned so that the cutting edge corresponding to one of the radially directed sides is parallel to and closely adjacent one longitudinal edge of the strip. The other part of the strip, which has not been punched during the first operation, is moved out of the punch tool and coiled on a winder-recoiler, after which this sheet strip portion is fed back through the punching tool, with such an orientation with respect to the strip that the cutting edge is parallel to and substantially coincides with the second side of the strip.

BRIEF DESCRIPTION OF THE DRAWINGS

In the following the invention will be described with reference to the accompanying drawings, in which FIG. **1** shows a device intended for a method according to the invention and FIG. **2** shows a section along the line II—II of FIG. **1**. FIG. **3** shows a sheet segment of annular sector shape which is manufactured according to the invention. FIG. **4** is a detail of FIG. **3**. FIG. **5** is a section on the line A—A of FIG. **4**. FIG. **6** is a section on the line B—B of FIG. **5**.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

In the drawings **15** designates a press in which a punching tool **5** with a lower part **3** and an upper part **4** are arranged. It is the task of the loop sag indicator **16** to keep a sheet metal strip **2**, which is fed in by means of a feeding mechanism **17**, sufficiently slack. Each time the lower and upper parts of the punching tool are pressed together by the press **15**, the segments **6** of the portion of the sheet metal strip **2** lying closest to the edge **11** are punched out. Between two consecutive segment punchings in the strip **2** a sheet metal projection is formed, in which the portion **18** marked with a lattice in FIG. **2** constitutes material which cannot be used, so-called contour scrap. The contour scrap **18** is cut off by means of an automatic, displaceable cutting machine **19**, working at the same rate as the punching tool, after which the remaining strip portion **13** forms a loop controlled by a loop sag indicator **20** before it is moved into a brake device **21** in order to be finally gathered on a winder-coiler **14**. After this the coiled sheet metal strip is moved over the winder-recoiler **1** at the feeding side of the press **15** for punching of the second strip half **13** in a second process in the press. During this second stage, the second half of the strip is reversed in its position with respect to the cutting tools, that is, for example, the drum on which it is wound may be turned around endwise.

In FIG. **4**, which is a detail of FIG. **2**, we have furnished the surface of the sheet metal strip with two different color symbols (instead of colors) in order to facilitate the understanding. In FIG. **4**, contour scrap which has arrived in the position where it is to be cut off along a straight line **30** by means of the cutter **19**, has been indicated by the symbol for yellow. This cutter **19** is shown in FIG. **5**. It is also shown in FIG. **6**. The cutter **19** has two teeth **22** and **23** which are arranged to work as a pair of scissors. Their positions are adjustable along the moving direction of the sheet metal strip and also crosswise by means of slots **25** and **26**, respectively. A resilient element **24** is arranged to keep the sheet in the correct position during the operation of the cutter **19**. The teeth or scissors **22** and **23** are fastened in slots **25** in beams **27**. One of the beams **27** is fastened to a table **28** and the other to a vertically moving upper part **29**. The main tool has auxiliary means for cutting along the line **31**.

FIG. **4** shows the situation at the moment when a segment **6** is about to be punched out. At that moment the scrap **38** which is left from the preceding punching is cut away by the scissors **22** and **23** along the straight line **30**.

As an alternative, the transfer of the sheet metal from coiler **14** to coiler **1** can be omitted, and instead the second cutting step in the press can be allowed to take place simultaneously with uncoiling the coiler **14**, while the press **15** is first turned 180°. Since the press is heavy and difficult to operate it is advantageous if the press instead has the necessary capability of being turned by providing it with a turnable portion which supports the punching tool, a strip feeder and a cutting machine. The cutting machine **19** and the feeding mechanism **17** are mounted firmly on the press or the turnable portion and keep their positions with respect to them during

the rotation. The press may, for example, be formed with a base which is separated from the rest of the machine along the line D—D of FIG. 1, so that the cutting section can be lifted and turned bodily by 180°.

Generally it may always be assumed that $r < B < 2R$, where B is the width of the strip and r and R are the internal and external radii of the segments (that is, the air gap radius and the maximum outer radius).

In the method described above it is of great importance that a tight and even coiling of the remaining strip half **13** is obtained. This is achieved by subjecting the strip half **13**, by means of the brake device **21**, to so great a tension that a tensile stress of more than 5 percent of the stress of the elastic limit arises. The method has been found to be particularly suitable for sheet thicknesses within the range 0.20 – 0.60 mm.

I claim:

1. Method of punching sheet segments having substantially annular sector shape, intended to form the stator core in a turbo-generator, each segments lying within a sector angle of 40° – 80° and being limited by a back side (**9**), a slot side (**10**) and two radially oriented sides (**7,8**), said method comprising feeding a sheet metal strip (**2**) of constant width from a winder-recoiler (**1**) between the lower part (**3**) and the upper part (**4**) of a punching tool (**5**), the working profile of which tool corresponds to the shape of said sheet segments (**6**), and individually and successively punching out a plurality of sheet segments by said tool, the sheet metal strip (**2**) having a width which is larger than the air gap radius and smaller than twice the maximum outer radius of said stator core, the punching tool being oriented in such a way that a cutting edge of the tool corresponding to one of said radially oriented sides (**7,8**) is parallel to and almost coincides with a first longitudinal edge (**11**) of said sheet metal strip, a remaining portion of the sheet metal strip (**13**) which is located adjacent a second longitudinal strip edge (**12**) and which is not affected during the punching being moved out by the punching tool by the feeding movement, coiling such remaining portion on a winder-coiler (**14**) and feeding such remaining portion into the punching tool (**5**), said tool having such an orientation in relation to the sheet strip that said cutting edge is parallel to and substantially coincides with said second longitudinal sheet strip edge (**12**).

2. Method according to claim **1**, which comprises transferring the sheet strip roll coiled on the winder-coiler (**14**) to the winder-recoiler (**1**) in coiled condition and thereafter feeding it through the punch.

3. Method according to claim **1**, which comprises feeding said remaining portion directly from the winder-coiler (**14**) after the punching tool (**5**) has been turned 180° in the horizontal plane.

4. Method according to claim **3**, in which said rotation includes turning a press part supporting said punching tool, a strip feeder and a cutting machine.

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