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(54) **METHOD FOR CREATING A CONDUCTIVE TRACK**

(57) The invention provides a method for manufacturing an electronic assembly (1). This method comprises the steps of providing a plastics substrate (3), applying a preliminary plasma flow (21) on a first zone (31) of the plastics substrate (3) by means of a first plasma nozzle (2), and directly depositing a conductive track (4) on the first zone (31).

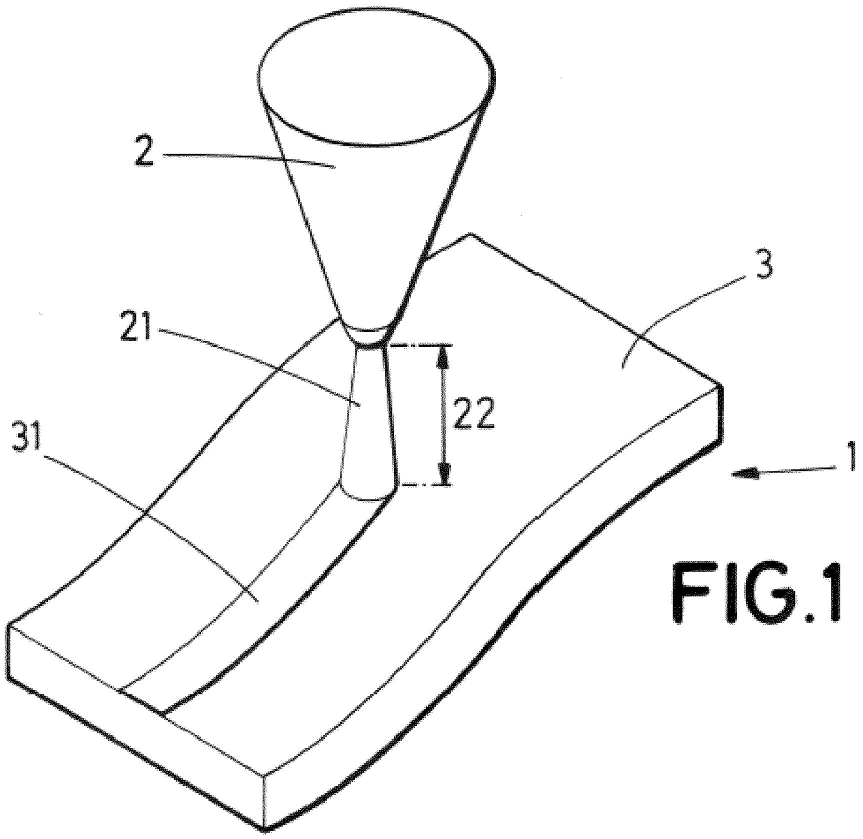

FIG.1

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Description

TECHNICAL FIELD

[0001] The present invention belongs to the field of electronic assemblies comprising conductive tracks directly deposited on a plastics substrate.

STATE OF THE ART

[0002] Plasma deposition is sometimes used to create a conductive track in a plastic part. This process comprises the step of including in the plasma flow some metal dust particles, usually copper, tin, aluminium or alloys of them, that are melted by the plasma flow and then deposited on the plastic part, thus creating a conductive track on said plastic part.

[0003] One example of this process may be found in document US 2015/174686 A1.

[0004] This metal deposition usually requires that the plastic surface is prepared enough. Some irregularities or even foreign objects which are present in the surface before the conductive track is created may affect to the performance or operation of said conductive track.

DESCRIPTION OF THE INVENTION

[0005] The invention provides a solution for this problem by means of a method for creating a conductive track according to claim 1. Preferred embodiments of the invention are defined in dependent claims.

[0006] In an inventive aspect, the invention provides a method for manufacturing an electronic assembly, the method comprising the steps of:

- providing a plastics substrate,
- applying a preliminary plasma flow on a first zone of the plastics substrate by means of a first plasma nozzle,
- directly depositing a conductive track on the first zone.

[0007] Such method advantageously provides a first step of preparing the surface of the plastics substrate for performing the second step. This first step has some effects on the surface of the plastics substrate. A first effect would be electrostatic charges removal, due to the electrostatic features of the plasma flow. A second effect would be foreign particles removal, including oils, release agents, plasticizers or liquid contaminants volatilization, due to the high temperature of the plasma flow. A third effect would be plastic base roughness or irregularities melted, also due to the high temperature of the plasma flow. A fourth effect would be the fluency of polymers part surface, making smoother metal deposition.

[0008] In some particular embodiments, the first plasma nozzle does not contain metal dust flow. Advantageously, it improves the effect of the preparation step.

[0009] In some particular embodiments, the conductive track is directly deposited by applying a main plasma flow with metal dust on the first zone. This step may be carried out, for instance, using the device described in document US 2015/174686 A1, and concretely in its claim 1.

[0010] These particular embodiments use a simple technique to create the conductive track. The result is a layer directly laid on the plastics substrate.

[0011] In some particular embodiments, the first step is carried out with the first plasma nozzle being at a first distance of the plastics substrate, and the second step is carried out with the second plasma nozzle being at a second distance of the plastics substrate, the second distance being the same or lower than the first distance.

[0012] This method improves the effects of the preliminary plasma flow in the plastics substrate.

[0013] In some particular embodiments, the first plasma nozzle is the same as the second plasma nozzle. This makes this method simpler, faster and less expensive.

[0014] In some particular embodiments, the first distance is comprised between 23 and 25 mm. This has been found to be a good distance for performing this step.

[0015] In some particular embodiments, the second distance is comprised between 21 and 23 mm. This has been found to be a good distance for performing this step.

[0016] In some particular embodiments, the first plasma nozzle moves at a speed comprised between 0.015 and 0.04 m/s, preferably between 0.018 and 0.022 m/s. This has been found to be a good speed for performing this step, the metal dust being deposited in the plastics substrate with a good compaction and low thickness.

[0017] In some embodiments, the preliminary plasma flow is created with a microwave frequency between 40 and 65 kHz, preferably between 60 and 65 kHz. This range improves the effects caused by the first step.

[0018] In some embodiments, the preliminary plasma flow is created applying an electric power between 0.95 and 1.05 kW. This range improves the effects caused by the first step without spending too much electrical power.

[0019] In some particular embodiments, the preliminary plasma flow exits the first plasma nozzle at a flow rate comprised between 1.30 and 1.35 l/s. This range improves the effects caused by the first step without spending too much plasma flow.

[0020] In some particular embodiments, the conductive track is applied on a subregion of the first zone.

[0021] A subregion the first zone should be understood as a portion of this first zone. The first zone is a prepared zone, and the conductive track is applied inside this first zone, but not necessarily covering the whole first zone. However, in other cases, the subregion could cover the whole first zone. In some particular cases, the first zone is a strip and the subregion is another strip which is narrower than the first zone.

[0022] This method ensures that the conductive track being laid by the main plasma flow is laid on a surface which has been previously prepared, by including this safety margin, so that little errors do not cause the conductive track being deposited outside this prepared zone.

[0023] In another inventive aspect, the invention provides an electronic assembly obtained with a method according to the previous inventive aspect.

[0024] This electronic assembly may be used in more challenging environments than the standard electronic assemblies, since the conductive track comprised in it is attached to the plastics substrate in a stronger way.

[0025] In another inventive aspect, the invention provides a lighting device for automotive vehicle comprising

an electronic assembly according to the previous inventive aspect
a semiconductor light source in electric connection with the electronic assembly;
an optical element suitable for receiving light emitted by the light source and for shaping the light into a light pattern projected outside the lighting device; and
a housing accommodating the electronic assembly, the semiconductor light source and the optical element.

[0026] An optical element is an element that has some optical properties to receive a light beam and emit it in a certain direction and/or shape, as a person skilled in automotive lighting would construe without any additional burden. Reflectors, collimators, light guides, projection lenses, etc., or the combination thereof are some examples of these optical elements.

[0027] Lighting devices for automotive vehicles can benefit from the use of electronic assemblies comprising conductive tracks which are deposited on a plastics substrate in a stronger way. In the first place, a wide range of the lighting device's parts can be used either as plastics substrate or as base for the plastics substrate (in which case the plastics substrate may for instance coat the base), taking into account that even three-dimensional plastics substrates are suitable for direct deposition of conductive tracks. This method ensures that the conductive track will grip better even on irregular surfaces. Therefore, a dedicated printed board circuit is not required, which leads to reducing the cost and the weight of the lighting device. As was stated above, cost savings are even more significant due to the fact that direct deposition does not normally want removing conductive material to shape the conductive tracks.

BRIEF DESCRIPTION OF THE DRAWINGS

[0028] To complete the description and in order to provide for a better understanding of the invention, a set of drawings is provided. Said drawings form an integral part of the description and illustrate an embodiment of the invention, which should not be interpreted as restricting the scope of the invention, but just as an example of how the invention can be carried out. The drawings comprise the following figures:

Figure 1 shows a first step of a method for manufacturing an electronic assembly according to the invention.

Figure 2 shows a second step of a method for manufacturing an electronic assembly according to the invention.

Figure 3 shows a lighting device comprising an electronic assembly in an automotive vehicle.

DETAILED DESCRIPTION OF THE INVENTION

[0029] Figure 1 shows a first step of a method for manufacturing an electronic assembly 1 according to the invention.

[0030] In this figure, a preliminary plasma flow 21 is applied on the plastics substrate, by means of a first plasma nozzle 2. This first plasma nozzle 2 is set at a first distance 22 from the plastics substrate 3, this first distance 22 being between 23 and 25 mm. Further, this first plasma nozzle 2 moves at a speed comprised between 0.018 and 0.022 m/s.

[0031] The preliminary plasma flow 21 is created with a microwave frequency between 60 and 65 kHz, applying an electric power between 0.95 and 1.05 kW. This preliminary plasma flow 21 exits the first plasma nozzle 2 at a flow rate comprised between 1.30 and 1.35 l/s.

[0032] The preliminary plasma flow 21 acts on a first zone 31 of the plastics substrate 3. This first zone 31 is prepared to receive a conductive track 4, as it has been prepared by the preliminary plasma flow 21, by removing debris and irregularities of the plastics substrate 3.

[0033] Figure 2 shows a second step of a method for manufacturing an electronic assembly according to the invention.

[0034] In this figure, a second plasma nozzle 5 different from the first plasma nozzle 2 applies a main plasma flow 51 on the plastics substrate 3. In other embodiments, this step is carried out by the same first plasma nozzle 21.

[0035] The main plasma flow 51 differs from the preliminary plasma flow 21 in that the main plasma flow 51 further contains metal dust particles. These particles are introduced in the main plasma flow 51, inside or outside the plasma nozzle, and then melt by the high temperatures of the main plasma flow 51. When they reach the plastics substrate 3, they solidify on it, thus creating a conductive track 4 on the plastics substrate 3.

[0036] This second plasma nozzle 5 is set at a second distance 52 from the plastics substrate 3, equal or lower than the first distance 22. In this particular embodiment, this second distance 52 is between 21 and 23 mm.

[0037] As seen in this figure, the conductive track 4 deposited by the main plasma flow 51 affects a subregion of the first zone 31, so that even in the event of little errors, the conductive track 4 is always deposited on a zone which has been previously prepared to receive it.

[0038] The electronic assembly 1 which has been manufactured according to this method comprises a smoother and more regular zone on the plastics substrate with respect to the electronic assemblies manufactured by the methods known in the state of the art. This method provides the conductive track with a more favourable location to be installed, without contaminants or irregularities, thus achieving a long-lasting arrangement of the conductive track 4 on the plastics substrate 3. Further, electrical conductivity in this track is improved, due to the fact that electrical flow is not dispersed within the contaminants.

[0039] Figure 3 shows a lighting device 10 for an automotive vehicle comprising

an electronic assembly 1 as shown in figure 2
a semiconductor light source 6 in electric connection with the electronic assembly 1;
a reflector 71, and a projection lens 72, suitable for receiving light from the semiconductor light source 6 and projecting it in the shape of a light pattern in a forward direction; and
a housing accommodating the electronic assembly 1, the semiconductor light source 6, the reflector 71 and the projection lens 72.

[0040] The forward direction should be understood as the advance direction of an automotive vehicle where the lighting device is intended to be installed.

[0041] In the particular embodiment shown in this figure, the optical elements include a reflector 71 and a projection lens 72. The reflector 71 is placed in the electronic assembly 1, arranged to reflect the light emitted by the semiconductor light source 6. The projection lens is in turn located in a forward position with respect to the lighting device 10, and receives the light from the light source 6 which has been reflected by the reflector 71. The projection lens 72 orientates this received light according to the vehicle advancing direction.

[0042] These optical elements 71, 72 makes the lighting device 10 suitable for being installed in an automotive vehicle 100 and able to perform lighting functions, such as high-beam and low-beam.

Claims

1. Method for manufacturing an electronic assembly (1), the method comprising the steps of:

   - providing a plastics substrate (3),
   - applying a preliminary plasma flow (21) on a first zone (31) of the plastics substrate (3) by means of a first plasma nozzle (2),
   - directly depositing a conductive track (4) on the first zone (31).

2. Method for manufacturing an electronic assembly (1) according to claim 1, wherein the preliminary plasma flow (21) does not contain metal dust flow.

3. Method for manufacturing an electronic assembly (1) according to any of claims 1 or 2, wherein the conductive track (4) is directly deposited by applying a main plasma flow (51) with metal dust on the first zone (31) by means of a second plasma nozzle (5).

4. Method for manufacturing an electronic assembly (1) according to any of the preceding claims, wherein the preliminary plasma flow (21) is applied with the first plasma nozzle (2) being at a first distance (22) of the plastics substrate (3), and the main plasma flow (51) is applied the second plasma nozzle (5) being at a second distance (52) of the plastics substrate (3), the second distance (52) being the same or lower than the first distance (22).

5. Method for manufacturing an electronic assembly (1) according to claim 4, wherein the first distance (22) is comprised between 23 and 25 mm.

6. Method for manufacturing an electronic assembly (1) according to any of claims 3 to 5, wherein the first plasma nozzle (2) is the same as the second plasma nozzle (5).

7. Method for manufacturing an electronic assembly (1) according to any of claims 4 to 6, wherein the second distance (52) is comprised between 21 and 23 mm.

8. Method for manufacturing an electronic assembly (1) according to any one of the preceding claims, wherein the first plasma nozzle (2) moves at a speed comprised between 0.015 and 0.04 m/s, preferably between 0.018 and 0.022 m/s.

9. Method for manufacturing an electronic assembly (1) according to any of the preceding claims, wherein the preliminary plasma flow (21) is created with a microwave frequency between 40 and 65 kHz, preferably between 60 and 65 kHz.

10. Method for manufacturing an electronic assembly (1) according to any of the preceding claims, wherein the preliminary plasma flow (21) is created applying an electric power between 0.95 and 1.05 kW.

11. Method for manufacturing an electronic assembly (1) according to any of preceding claims, wherein the preliminary plasma flow (21) exits the first plasma nozzle (2) at a flow rate comprised between 1.30 and 1.35 l/s.

12. Method for manufacturing an electronic assembly (1) according to any of preceding claims, wherein the

conductive track is applied on a subregion of the first zone (31).

13. Electronic assembly (1) obtained with a method according to any one of the preceding claims.

14. Lighting device (10) for automotive vehicle (100) comprising
the electronic assembly (1) of claim 13;
a semiconductor light source (6) in electric connection with the electronic assembly (1);
an optical element (71, 72) suitable for receiving light from the light source (6) and projecting it in the shape of a light pattern in a forward direction; and
a housing (12) accommodating the electronic assembly (1), the semiconductor light source (6) and the optical element (71, 72).

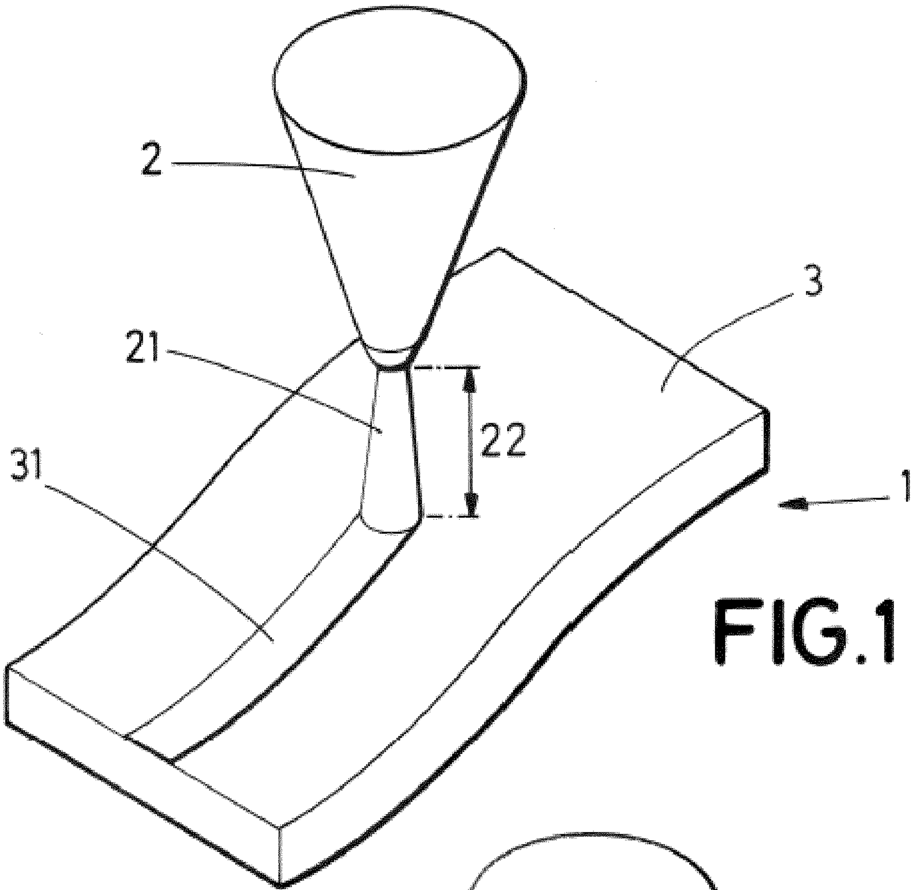

FIG.1

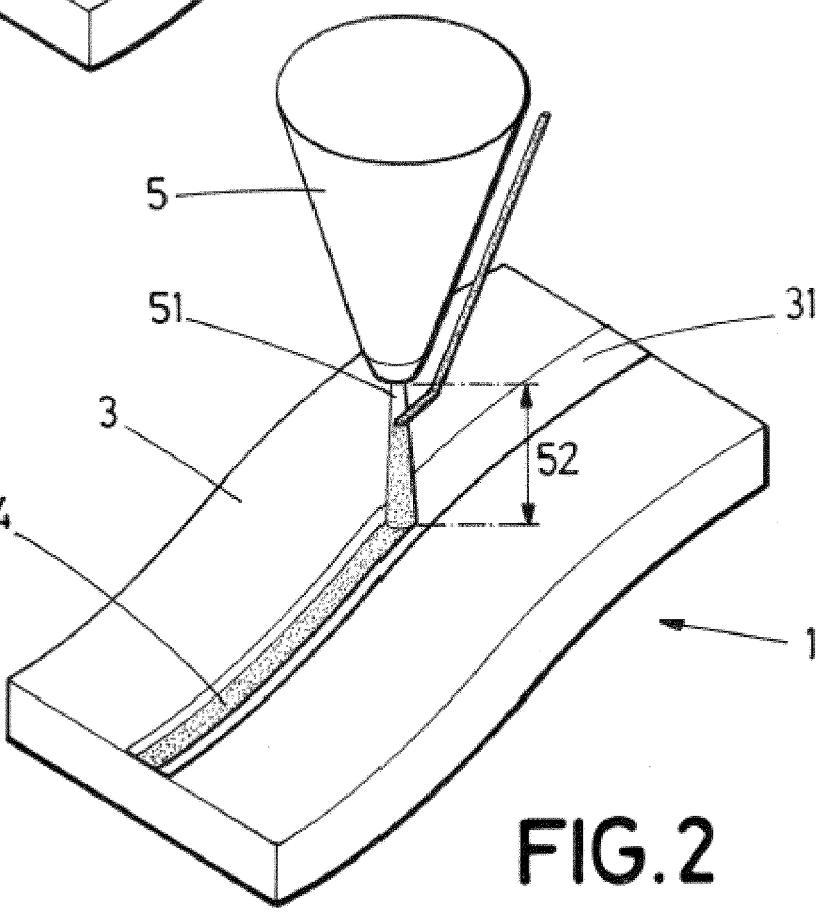

FIG.2

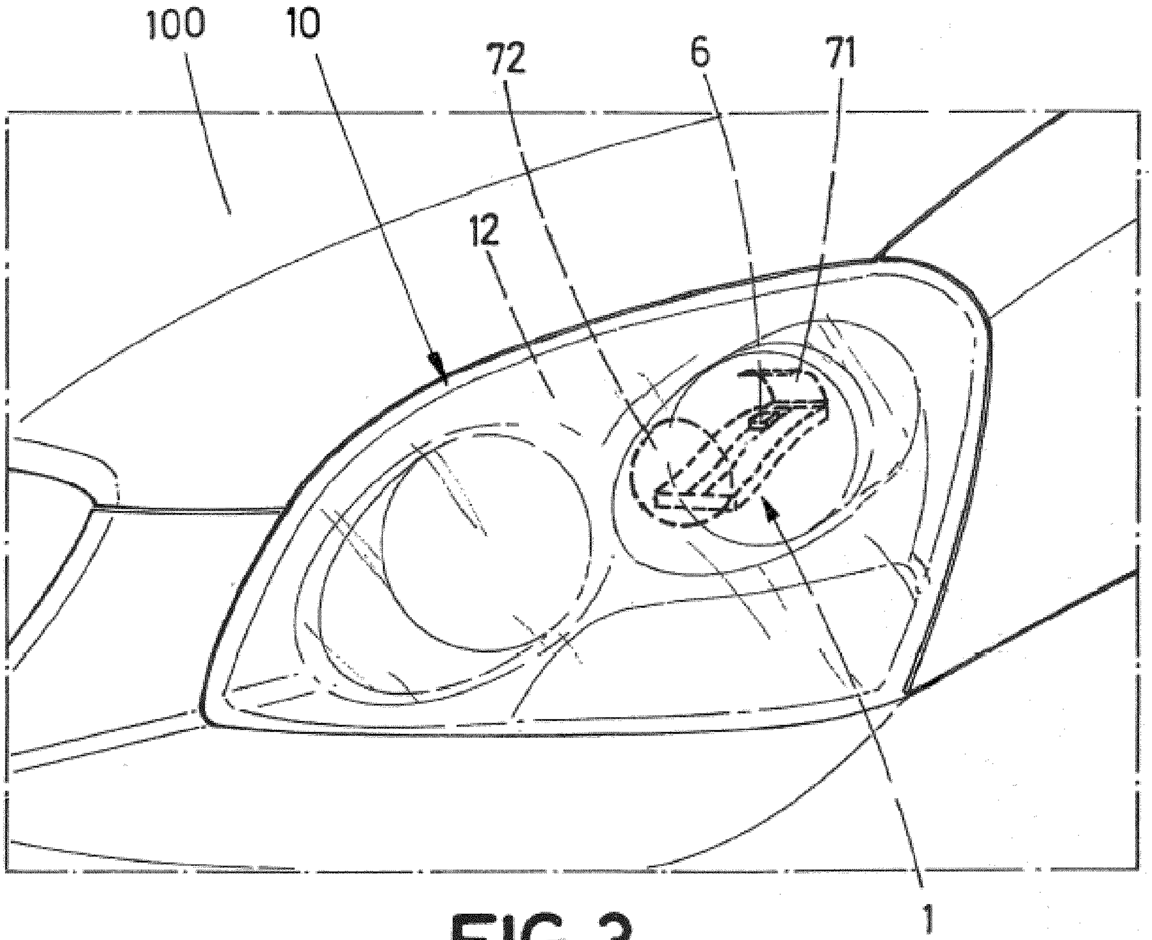

FIG.3

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EUROPEAN SEARCH REPORT

Application Number
EP 16 38 2563

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The present search report has been drawn up for all claims

1

Place of search	Date of completion of the search	Examiner
Munich	12 May 2017	Teppo, Kirsi-Marja

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

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