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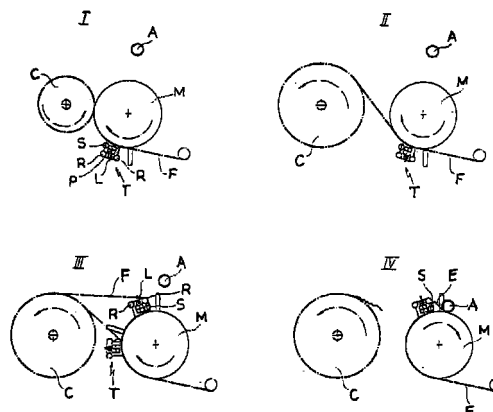
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(54) **Automatic winding machine for continuously extruded plastic films**

(57) An automatic winding machine to be combined with a continuous extrusion plant of a plastic film (F) includes a motor-driven winding roller (M) on which the film (F) passes and a cutting unit (T) parallel to the roller (M) and rotatable therearound, the cutting unit (T) including a blade (L) to cut transversely the film (F) and also a blowing bar (S) connected to a source of pressurized fluid and controlled by a valve in order to push the terminal edge (E) of the film (F), cut by the blade (L), so that it winds up on a new winding core (A). This novel structure of the cutting unit (T) provides for an automatic change of the complete reel (C) both when the winding takes place in the usual direction with the film (F) passing over the roller (M) and when the winding takes place in the reverse direction with the film (F) passing under the roller (M).



**Fig.1**

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## Description

[0001] The present invention relates to plants for the extrusion of plastic films, and in particular to an automatic winding machine to be combined with a continuous extrusion plant.

[0002] It is known that substantially continuous manufacturing processes are used in the production of industrial films, especially in the production of extruded films made from plastic materials such as low and high density polyethylene (LDPE, HDPE), ethylvinyl acetate (EVA) and similar extrudible thermoplastic materials. These productions employ various extrusion and coextrusion processes, both of single sheet linear films and tubular films, which can be wound up as such or as two single films by cutting the folding edges of the tube and separating the two sheets so as to wind them separately on two winding reels.

[0003] In any case, the terminal apparatus of any production line of continuous films is necessarily a winding machine suitable to form reels of film, wound around a tubular winding core, having a preset diameter or weight. For obvious reasons of compatibility of this winding machine with the continuous manufacturing process of the film, it must be able to cut the film upon completion of a reel, simultaneously starting to wind the film around a new tubular winding core while the complete reel is being discharged, in a completely automatic way.

[0004] In these machines the winding motion is typically achieved by contact between a motor-driven winding roller and the reel being wound which abuts on said roller, by exploiting the weight of the reel whose core is inserted on a mandrel whose ends are received in seats located at the ends of rotatable arms, which are driven by hydraulic cylinders. An improvement over this solution is provided by the addition of a system for controlling the contact pressure between the reel and the motor-driven roller so as to assure a constant contact pressure while the reel weight increases. This control is usually achieved by subjecting said hydraulic cylinders to an automatic system according to the pressure exerted by the reel on the motor-driven roller, said pressure being detected through load cells located on the roller supports and/or through the monitoring of the pulling tension exerted on the continuous film.

[0005] The motor-driven winding roller is generally provided with an outer rubber coating in order to increase the film pulling capacity and to favour a uniform tangential contact with the reel. However this is not always necessary and steel rollers without rubber coating, with a smooth or knurled surface, are used for some kinds of film. The roller may also be provided with a plurality of bores and a suction system so as to keep the film adherent to its surface.

[0006] A similar type of winding machine allows an advantageous simplification of the system for controlling the contact pressure between the reel and the roller by

getting rid of the necessity of detecting the tension of the continuous film and/or the pressure on the roller while also completely eliminating the dependency from the (changing) weight of the reel during a complete winding cycle. In this case, the mechanism which supports the reel and adjusts the contact pressure consists of a pair of carriages or slides, horizontally mobile in a direction essentially radial with respect to the rotation axis of the motor-driven roller. Consequently, the axis of the mandrel of the reel being wound lies substantially on the same plane of the rotation axis of the roller, whereby a perfectly constant contact pressure can be easily assured throughout the whole winding cycle by means of a stemless pneumatic cylinder or similar actuator, whose action can be doubled on both slides by using chain transmissions and other connecting members. As the reel diameter increases, the mandrel axis moves away parallel with respect to the roller axis until it reaches an end position where the complete reel is discharged from the winding machine by means of a pair of rotatable arms.

[0007] Some winding machines also have the option of providing the winding mandrel with its own rotatory motion, automatically adjustable so as to keep the tangential velocity of the increasing reel adapted to the tangential velocity of the motor-driven roller, so as to reduce the occurrence of uneven tensions in the wound up film. For winding up particularly thin and/or particularly delicate films it is also known to use a so-called "gap winding" technique, i.e. keeping the reel some millimeters away from the motor-driven winding roller and using only the winding mandrel's own rotatory motion.

[0008] Therefore, the most sophisticated winding machines provide a choice between three operating modes according to the type of film to be processed, namely: a) winding by transmission of the motion from the motor-driven roller to the reel which is kept in contact at a constant pressure; b) winding by the own rotatory motion of the winding mandrel of the reel (gap mode); c) winding by contact and own rotation (mixed mode). Such a winding machine patented by the same inventor of the present application is disclosed in the Italian patent n.1.260.574.

[0009] Regardless of the selected winding mode, the automatic change of the reel takes place with the aid of a cutting unit parallel to the motor-driven roller and rotatable therearound in the same direction of rotation. Said cutting unit essentially consists of a pair of small idle rollers between which a blade can slide transversely with respect to the film feed direction.

[0010] In a few words, the reel change takes place by rotating the cutting unit around the motor-driven roller along the rear portion thereof, referring to the rear portion as the portion opposite to the area of contact with the reel being wound. Therefore, the cutting unit moves from its rest position in the lower half of the motor-driven roller to its operating position in the upper half of the roller, close to the area of contact with the reel

(or to the area of gap crossing). In this way, the rollers of the cutting unit temporarily lift the film from the surface of the winding roller, while a new tubular core put on a winding mandrel, and having the outer surface made suitably adhesive, is carried into contact with the surface of the film on the motor-driven roller just upstream from the cutting unit. At this moment, the blade cuts the film and the film edge adherent to the adhesive surface of the new winding core starts to wind up thereon, thus resulting in a new reel. Upon removal of the complete reel, the new reel being wound is rotated around the motor-driven winding roller and taken to its usual winding position, which is free from the removed reel, preceded by the cutting unit which completes the rotation and returns to its rest position.

**[0011]** Sometimes it is useful to be able to employ the winding machine to perform a reverse winding, i.e. a winding wherein the motor-driven roller rotates in the opposite direction with the film being pulled along the lower half thereof instead of the upper half. Such a reversal of the winding direction allows to wind on the inside of the reel the film surface opposite to the surface which is usually wound on the inside, e.g. the outer surface of the extrusion "bubble" rather than the inner surface thereof.

**[0012]** However, the above-described procedure for the automatic change can not be applied to such a reverse winding. In fact, it is clear that if the cutting unit makes the same movement as described above, passing along the rear side of the motor-driven roller, it does not come up against the film and therefore can not cut it. Furthermore, even if it rotates in the same direction of the roller by passing along the front side thereof (upon moving away of the reel), still it could not take the film in contact with the new core coming down on the upper portion of the roller. Therefore, it is presently necessary for the plant operator to carry out manually the film cutting and the starting of the new reel by manual positioning of the film edge on the new core.

**[0013]** It is clear that these manual operations have several drawbacks, such as a risk for the operator who has to enter an operating automatic plant, the fact that the good outcome of the change depends on the operator's ability, the slowness of the operation which negatively affects the speed and continuity of the production.

**[0014]** Therefore the object of the present invention is to provide a winding machine suitable to overcome the above-mentioned drawbacks.

**[0015]** This object is achieved by means of a winding machine having the characteristics disclosed in claim 1. Other advantageous features are disclosed in the dependent claims.

**[0016]** A first fundamental advantage of this kind of winding machine is that it can operate in a fully automatic way in both winding directions, with significant advantages as to safety, reliability and speed.

**[0017]** A further advantage of the present winding machine is that it provides an automatic change in the

usual winding direction without requiring to make adhesive the outer surface of the new core, as it will be made clear further on. In this way, the preparation of the new cores is simplified and the handling thereof is made easier.

**[0018]** These and other advantages and characteristics of the winding machine according to the present invention will be clear to those skilled in the art from the following detailed description of an embodiment thereof, with reference to the annexed drawings wherein:

**Fig.1** is a highly diagrammatic side view showing the automatic change procedure in the case of reverse winding; and

**Fig.2** is a view similar to the preceding one and showing the automatic change procedure in the case of normal winding.

**[0019]** With reference to fig.1, there is seen that the change procedure is illustrated through four steps sequentially numbered from I to IV. The structure of the winding machine is not described in detail since it is well known to a person skilled in the art, only some fundamental members being depicted in order to explain the operation thereof.

**[0020]** As seen in step I, during the reverse winding the film F is fed to the lower portion of the motor-driven roller M which is in contact in its front portion with the reel C being wound. The cutting unit T is in its rest position in the lower portion of the roller M, the film F passing between the latter and the cutting unit T, while the new core A carried by the replacement mandrel is in its waiting position above the roller M.

**[0021]** The cutting unit T conventionally includes a pair of idle rollers R located at the top, with a blade L sliding therebetween which is suitable to cut the film along the entire width thereof. The blade L is usually mounted on the carriage of a stemless pneumatic cylinder P controlled through electric valves connected to a source of pressurized fluid, typically compressed air.

**[0022]** A novel feature of the winding machine according to the present invention is the presence of a "blowing bar" S, located close to the base of the cutting unit T on the side opposite to the reel C when the cutting unit T is in its cutting position (step III). Said "blowing bar" S extends along the whole width of the cutting unit T and is provided with one or more rows of bores, or a single elongated nozzle, as well as with an electric valve also connected to a source of pressurized fluid, preferably the same source supplying the actuator P of the blade L. The function of this bar S will be clear from the following description of the operating steps of the automatic change of the present winding machine.

**[0023]** Step II illustrates the moment when the almost complete reel C is moved away from the roller M by translation of the horizontal supporting slides, or other type of mandrel supporting member, in order to allow the passage of the cutting unit T along the front

portion of the roller M. Since the winding of the film F must continue also during said moving away, the reel C is maintained into rotation by means of the mandrel's own rotatory motion. In case the winding takes place during step I only by contact with the roller M, and not in mixed or gap mode as described above, the rotation of the mandrel is started in advance with respect to the removal of the reel C so as to have the time to synchronize the speed of the mandrel with the speed of the roller M.

**[0024]** Step III illustrates the movement of the cutting unit T to its cutting position in the upper portion of the roller M, slightly upstream from the point where the new winding core A comes down. As seen in the figure, during said movement the cutting unit T takes along therewith the film F, thus moving upwards the point where the film leaves the surface of the roller M to go to the reel C. At the end of the rotation of the cutting unit T, the film F passes around the latter touching first the blowing bar S and then the roller R immediately above while in general it does not touch the other idle roller R (except in the case of a small diameter reel C).

**[0025]** Step IV illustrates the moment of the real change, when the new core A has been lowered in contact with the roller M prior to operating the blade L to cut the film F so as to remove the complete reel C. At the same moment when the electric valve controlling the pneumatic cylinder of the blade L is opened, also the electric valve of the bar S is opened so as to emit for some seconds a jet of air along the entire width of the film F. In this way, the terminal edge E of the just cut film F is pushed by the jet of air so as to be "nipped" between the roller M and the new core A (having an adhesive surface) and to start winding thereon. In order to make this step easier, the roller M is preferably made with a surface suction system, so as to attract the edge E towards its surface and thus cooperate with the jet of air emitted by the bar S.

**[0026]** In the final step of the change (not illustrated) the cutting unit T goes back to its rest position through a reverse path with respect to the path described above, i.e. it passes again in front of the roller M, and the new reel follows it reaching its normal winding position as shown in step I.

**[0027]** As mentioned above, the above-described novel type of winding machine is also advantageous in the automatic change of reels wound up in the usual direction in that it allows to get rid of cores prepared with an adhesive surface. This is still achieved thanks to the blowing bar S as diagrammatically shown in fig.2.

**[0028]** In step I of fig.2 there is illustrated the winding in the usual direction of a reel C', which takes place with the passage of the film F along the upper portion of the reel M while the cutting unit T still has a rest position below the roller M. It should be noted that the only difference with respect to the preceding case is the reversed rotation of the roller M and therefore of the reel C', while the structure of the winding machine does not require

any modification.

**[0029]** Step II illustrates the situation just before the automatic change, when the cutting unit T has rotated to its cutting position, by passing along the rear portion of the roller M and thus slipping under the film F, and the new core A has come down into contact with the roller M just upstream from the cutting unit T. In this situation the film F is still being wound on the reel C' by passing under the new core A and over the two rollers R of the cutting unit T. At the moment when the blade L and the blowing bar S are operated, the terminal edge E of the just cut film F is pushed by the jet of air to pass over the core A and therefore ends up being nipped between the latter and the roller M on the side opposite with respect to the cutting unit T. In this way, the winding of the new reel is started without having to make the core A adhesive.

**[0030]** In the final step (not illustrated) the complete reel C' is moved away and the cutting unit T completes its rotation by passing in front of the roller M to go back to its rest position, followed by the new reel which reaches its winding position.

**[0031]** Therefore it is clear that the present novel winding machine provides for the reel change in a completely automatic way and with full safety regardless of the winding direction and mode being used.

**[0032]** It should be noted that the cutting unit T may advantageously include a second blade higher than the blade L shown in the figures. This higher blade may be necessary in the case of large diameter reels wound up in the reverse direction, since in this situation (step III of fig.1) the film F may pass at a rather significant distance above the cutting unit T.

**[0033]** Furthermore, the blowing bar S may be made adjustable around its longitudinal axis so as to change the push angle of the jet of air according to the winding direction being used. In other words, in the case of fig.1 the push will be directed in a lower direction with respect to the case of fig.2 where the edge E must pass over the core A.

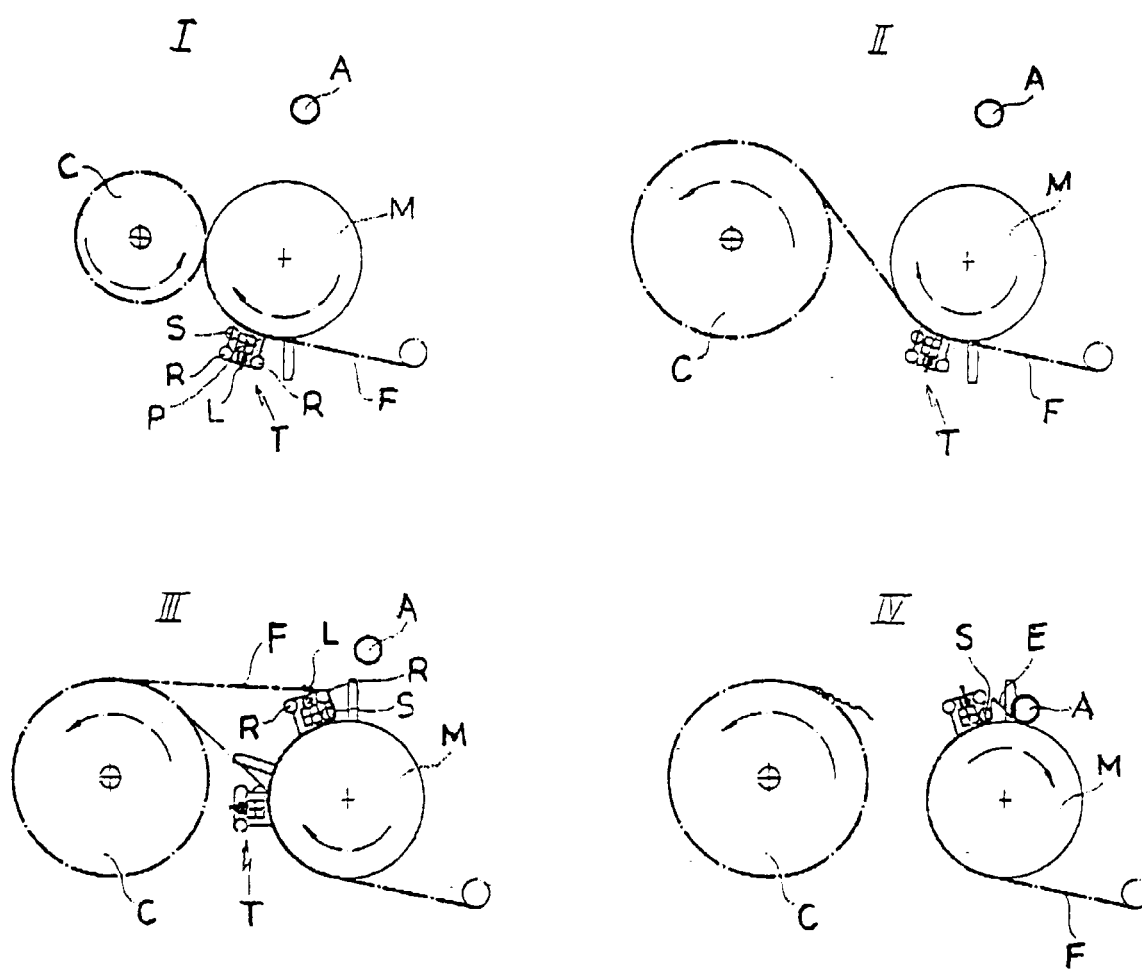
**[0034]** It is clear that the above-described and illustrated embodiment of the winding machine according to the invention is just an example susceptible of various modifications. In particular, the blowing bar S could be replaced by another kind of member suitable to provide a push to the terminal edge E, e.g. a retractable pusher or other mechanic means. Similar replacements of mechanically equivalent means are also possible with respect to the other members of the present winding machine.

## Claims

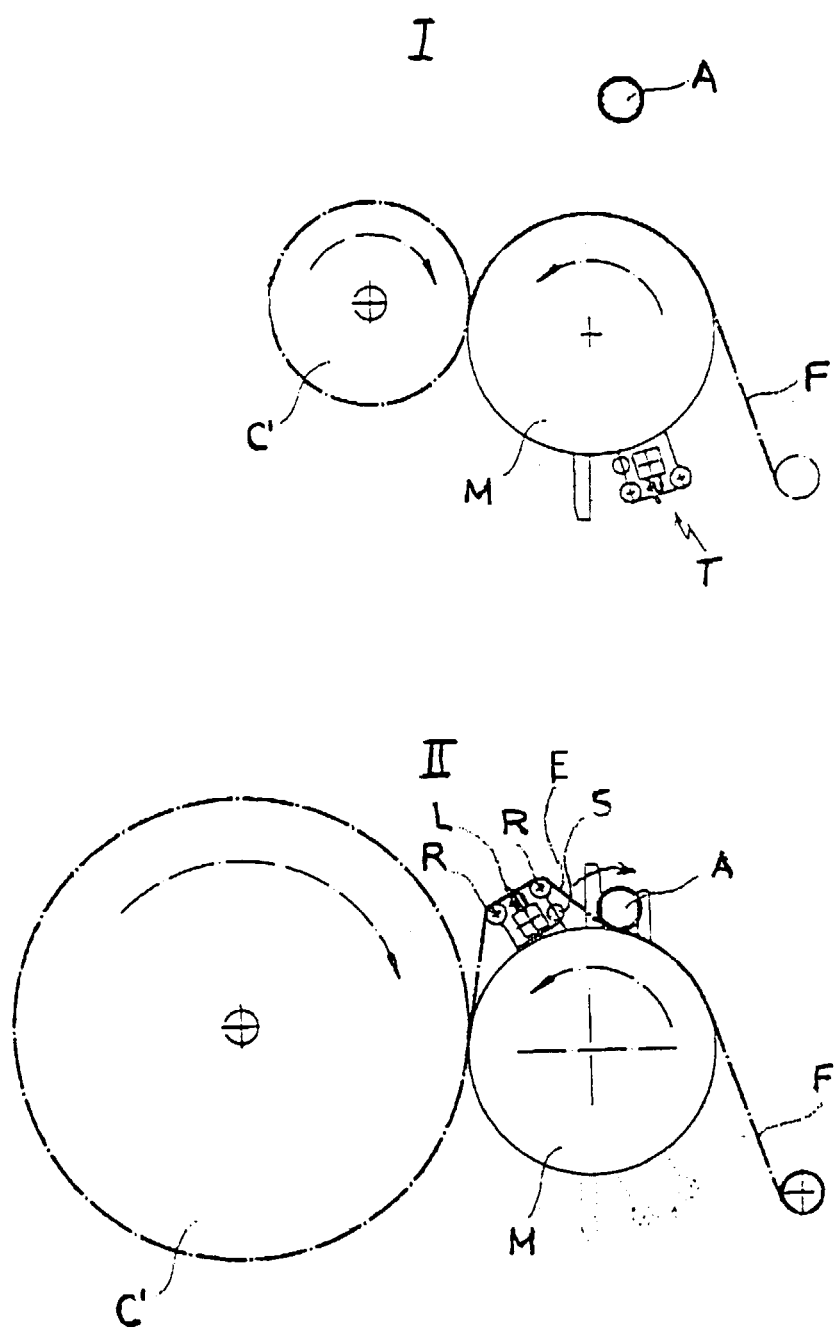
1. A winding machine suitable to wind up in reels (C, C') a continuous plastic film (F), including a motor-driven winding roller (M) on which said film (F) passes, means suitable to bring a winding core (A) in contact with said motor-driven roller (M), and a

cutting unit (T) parallel to the motor-driven roller (M) and rotatable therearound, said cutting unit (T) including at least one blade (L) suitable to cut the film (F) transversely with respect the feed direction thereof, characterized in that the cutting unit (T) further includes means for pushing the terminal edge (E) of the film (F) cut by said blade (L), said pushing means being located on the cutting unit (T) so as to be on the opposite side with respect to the reel (C, C') when the cutting unit (T) is in the cutting position. 5 10

2. A winding machine according to claim 1, characterized in that the pushing means consist of a blowing bar (S) provided with one or more nozzles and with a connection to a source of pressurized fluid, said connection being controlled by valve means. 15
3. A winding machine according to claim 2, characterized in that the same connection providing the operation of the blowing bar (S) also supplies an actuator of the blade (L), the latter being controlled by separate valve means. 20
4. A winding machine according to one or more of the preceding claims, characterized in that the cutting unit (T) includes a second blade higher than the first blade (L). 25
5. A winding machine according to one or more of the preceding claims, characterized in that it includes means suitable to provide an own rotatory motion to the mandrel carrying the winding core (A). 30
6. A winding machine according to claim 5, characterized in that it includes means suitable to synchronize the own rotatory motion of the mandrel with the motion of the motor-driven roller (M). 35
7. A winding machine according to one or more of the preceding claims, characterized in that it includes means suitable to reverse the direction of rotation of the motor-driven roller (M). 40
8. A winding machine according to one or more of the preceding claims, characterized in that it includes means suitable to control the direction and amplitude of the movement of the cutting unit (T) around the motor-driven roller (M). 45 50
9. A winding machine according to one or more of the preceding claims, characterized in that the motor-driven roller (M) is provided with a plurality of bores and a suction system suitable to keep the film (F) adherent to its surface. 55



***Fig. 1***



***Fig. 2***



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# EUROPEAN SEARCH REPORT

Application Number  
EP 98 83 0610

| DOCUMENTS CONSIDERED TO BE RELEVANT                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                                                                           |                                                      |                                                 |
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| Place of search<br>BERLIN                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                                                                                           | Date of completion of the search<br>26 February 1999 | Examiner<br>Fuchs, H                            |
| <p>CATEGORY OF CITED DOCUMENTS</p> <p>X : particularly relevant if taken alone<br/>Y : particularly relevant if combined with another document of the same category<br/>A : technological background<br/>O : non-written disclosure<br/>P : intermediate document</p> <p>T : theory or principle underlying the invention<br/>E : earlier patent document, but published on, or after the filing date<br/>D : document cited in the application<br/>L : document cited for other reasons<br/>&amp; : member of the same patent family, corresponding document</p> |                                                                                                                                           |                                                      |                                                 |

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**ANNEX TO THE EUROPEAN SEARCH REPORT  
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