

**PROCEDURE FOR ANTICORROSIVE TREATMENT
FOR BRAIDED CABLES AND PULLING SYSTEM**

5 This invention refers to a new procedure for the treatment of braided cables, of the kind that have a layer of zinc, however thin this may be, converting this into a rustproofing barrier without altering the mechanical properties of the cable, and a system for pulling the braided cable, which uses a variable-speed reduction motor for each pair of reels in each stage of the procedure.

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A great deal of cables are used nowadays in all kinds of applications. Taking as a base only the ones which are used to transmit a force and have to be resistant to the medium in which they are housed, for example, in the cable pulls for car windows, clutch cables, motorbikes etc., it can be said that at present the cable with good mechanical properties normally has low resistance to corrosion and vice versa.

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These cables are installed in sets or assemblies, whose other parts have a longer life, withstanding both the effect of corrosion and the mechanical strains to which these are subject. This implies that these cables are causing a need for greater maintenance of an assembly since these cables have to be changed more often than the other pieces.

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The kind of braided cable normally used is based on threads of stainless steel. This cable is very thick after drawing, that is, when metal threads are drawn, the greater the number of threads, the smaller the final diameter of the cable, since it can be bent better, withstanding greater strains through friction between the braided threads.

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This cable is ready for use after drawing, and though it has acceptable anticorrosive properties it can also be said that its mechanical properties are fairly deficient for working as window-winder in car doors, clutch cables etc., that is where there are minimum mechanical requirements such as traction, friction, twisting, compression, etc..

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These poor mechanical characteristics are basically due to the difficulty arising in drawing when this is attempted with a high number of threads since, as has already been stated, the greater the number of threads in a smaller final diameter, the better mechanical properties of the cable implied.

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Stainless steel is thus a hard material, difficult to draw, that is, if the intention is to draw with very fine threads this is a delicate job since they will easily break through being so fragile. There is no ductility in the cable, and so it will be difficult to bend and withstand tensions.

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Another cable used nowadays, which improves mechanical qualities as compared with stainless steel cable, uses a galvanized or electrozinc coated steel as its base metal, which is subjected to a tinning treatment, normally by electro-deposition.

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This consists of creating a fine layer of tin over the zinc of the galvanization or electrozinc coating of the steel. This tinning is normally applied by electrolysis, which involves an expensive and complex process which finally has repercussions on the price of the cable on the market.

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This tinned cable improves the rustproofing properties of the base metal, but even so does not comply with the requirements and requisites of certain sectors of the industry such as the automobile field. Anticorrosive protection is still weak and depending on the type of zinc (galvanized or electrozinc coating), on its initial thickness before drawing, the maximum time it withstands corrosion in a salt fog chamber (ONS) in a trial with 5% sodium chloride according to DIN 50021, does not exceed 200 hours (corrosion of the iron or base metal).

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This tinned cable thus involves an expensive and slow process since the electro-deposition stage is complex, and also needs installations for washing, neutralizing and cleaning, since the remains of the products used in this procedure are highly contaminating, and thus these materials require treatment before they can be dumped. This also involves part of the products used being lost in the neutralizing and cleaning of waste, therefore leading to two reasons for greater

expense - the installations required and the wasted material.

5 Whatever procedures may be used for obtaining cables with stainless steel base metal, or tinned cables, these materials are unstable on the market, in the sense that there are few producers of these materials, and prices are thus high and fluctuating, apart from their supply not always being guaranteed.

10 One kind of cable also commonly used is the galvanized steel variety, which has no later treatment after drawing, only with residual zinc. This cable is cheaper than the stainless steel or tinned cable kind, but it does not fulfil the requisites of the automobile industry either. Depending on the type of zinc and thickness of the coat, the maximum time the anticorrosive protection withstands corrosion in a salt fog chamber (ONS) in a trial with 5% sodium chloride according to DIN 50021 is between 24 and 72 hours (connection of the iron or base metal).

15 The corrosion test in an industrial climate (climatic chamber, 2 litres of SO₂) according to DIN norm 50.018 does not get through the first cycle without red corrosion (or of the base metal).

20 Other cables that are being used in the automobile sector, though not as widely as those already mentioned, are cables made of phosphated steel, without zinc and with a partially ferrous core of the cable. After the braiding operation these are phosphated, obtaining good mechanical properties but poor resistance to corrosion.

25 Pitched cable does not comply with anticorrosive requirements either. When these are bent a lot or subject to a high mechanical stress the resistances break, with this top coat flaking, and the flake so produced has a shear effect and provokes greater detachment of the coat.

30 Plastified cables should not be made to work in harsh mechanical conditions since they become deplastified.

Another sort of cable used in the automobile sector but without anticorrosive

properties is a copper or tinned cable used in tyres.

5 To sum up it can be said that at present braided cables do not comply with the requisites of the automobile and motor sector in general, either because they do not withstand corrosion well or if they do this reduces their mechanical qualities, involving greater maintenance apart from being more expensive cables with a shorter life.

DESCRIPTION OF THE PATENT

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By using the procedure that is the subject of this invention, the braided cable produced solves the disadvantages stated above at an economic price without the need for complex or contaminating installations.

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This treatment is based on the transformation of the zinc layer on a wire, although this coating is very scarce, with transformation of the zinc remaining after steel drawing, without the deposition of another metal, organic or synthetic resin, varnishes, etc., one obtains a final product with a high degree of resistance to corrosion and without substantial variations of the mechanical performance, in a final phase of the procedure by means of special lubrication.

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25 Due to being a cable made of threads of galvanized steel, this can be drawn with no difficulties, obtaining cables with a large number of threads and slender diameter, thus obtaining a ductile cable that is manoeuvrable and with good mechanical properties, since there is no later electrodeposition treatment to reduce these properties.

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30 Furthermore, the coat of chrome-silicon produced on top of the zinc layer creates a microcrystalline coat based on salts of zinc, iron, chrome and silicon, which to a large extent prevents the formation of corrosive rust on the base metal, even with large mechanical stresses in corrosive atmospheres. This hard friction-resistant layer is migratory, which means that after being damaged, it has the property of partly recovering its anticorrosive properties through humidity, and is thus ideal for maintaining its anticorrosive characteristics over the cable's whole

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life.

It has been proved that the corrosive protection of this braided cable, in a salt fog chamber trial according to DIN 50021, means that the minimum time it
 5 withstands corrosion is from 240 to 800 hours, depending on the layer of zinc, the base material and type of chromate applied or formed.

The chromate stage can be carried out either with chrome 6 (Cr^6) or chrome 3 (Cr^3) depending on the degree of rustproofing wished for, since Cr^6 under the
 10 same corrosion conditions gives a longer life than the cable treated with Cr^3 . Nevertheless, there are companies which will not accept pieces with Cr^6 on their mechanisms, and therefore this procedure allows either of the two possibilities to be used in the treatment.

15 This can be used on any base material which will take a coating of zinc, such as galvanized or electrozinc coated steels for example.

This is thus a procedure with high anticorrosive features, due to the layer of chrome-silicon; being economic and simple as it does not require stages such as
 20 electro-deposition which make the process more expensive and complicated; with little alteration of the mechanical properties; manoeuvrability and flexibility, and no loss of mass through flaking. In a continuous process the washing stage can optionally be eliminated, which gets rid of possible contamination and reduces costs, by means of draining and/or drying (by blowing or mechanical absorption
 25 of the wash load) or another well-known method which could be induction.

All the chrome-silicon remains in the treatment with no waste or contamination in the work process.

30 Lastly, depending on the final use of the braided cable, this can be given a lubrication stage based preferably on molybdenum sulphide or another organic or synthetic lubricant.

All this produces a cable which:

- means a lower maintenance cost for the assembly in which this is used.
- has many applications in salty and highly corrosive atmospheres
- is economical if this is compared with its long life, since the mechanical properties are maintained for the duration of real tests on this kind of cables.
- will take lubrication and colouring in the same treatment or a later one.
- is less contaminating.
- has anticorrosive properties remaining to a great extent after mechanical stresses received over its life.

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The cable (8) goes through the process, from one stage to another, by means of a pulling system based on the use of a motor, preferably electric, which is independent for each stage of the process. These motors turn at the beginning at the same speed, so that there is not such a high tension in the cable from the end of the process, this tension increasing as the process lengthens.

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The use of these mechanisms to make the reels turn means a considerable reduction in the tension of the cable, since the pulling force is provided in each stage of the process, and furthermore this force will not be traction based but instead applied through the turning of the drum or reel with a large pushing force, implying much greater distribution of forces and thus less tension on the cable.

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This pulling system is fitted with a speed regulating device for each motor, so that if one reel of cable were to become too taut or through a fault this means the motor would accelerate enough to even up tensions on the cable and resume the rated working turning speed.

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This regulating device consists of a counterweight on the cable, a lever arm with connecting rod/handle, a preferably analogical detector, a preferably vertical type speed variator regulator and the motor itself.

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The design of this invention will be understood better with the aid of the following drawings:

Figure 1. Diagram of the procedure in the treatment of braided cable.

Figure 2. Longitudinal view of the reels, with the motor, levers and regulating device.

Figure 3. Cross section of the reels with the pulley and counterweight system, etc..

5 Figure 4. Detail of the device for detecting variations in the cable tension.

As can be seen from Figure 1, there are a number of containers (1,2,3,4,5), 5 in this case, with any of these being replaceable depending on the case, in which a double slotted cylinder (6) is inserted, made up of slots (7) around which the
10 cable is wound and unwound (8). This cable is led along by guides or pulleys (9).

This process has a series of stages such as degreasing, in whose container (1) there is a detergent or similar (10); a drainer (11) at the exit from the former, and
15 the cable then goes on to a second container (3) for neutralizing and then a chromate bath (4) with a further draining (12) and drying stage (13) finally going to a sealing process (13) and a further draining (14) and drying (15).

The time that the cable has to remain in each step is not the same for all the stages, and for this reason, since reasons of economy mean that all the cylinders
20 (6) should preferably be identical and the turning speed will also be the same for all of these, the condition determining the length of their stay in each stage will be the number of turns that the cable is wound onto each cylinder or spool (6) so that the greater the number of turns the longer the cable will remain in the corresponding bath. Figure 2 shows two slotted cylinders through whose slots
25 (7) the wound cable (8) moves.

In turn these cylinders (6) are preferably hollow for weight reasons, and have a slot (7) through which the cable goes (8). These cylinders or reels (6) turn on two easily dismantled support pieces (19) each, which through a stub (20) form
30 the point for linkage and support with the graphited teflon bearings (17) which can give a certain amount of tilt in their housing (21) to the bodies (16) joined at the top to all the bodies of the remaining cylinders, so that by lifting this structure all the cylinders can be lifted (6) to be changed, cleaned, have new cable put on etc..

In the first stage of the process, the cable coming from a reel is submerged in a container (1) where there is a double cylinder (6) on which the cable (8) is wound, this being under the level of a degreasing liquid (10) so that this cable (8) is cleaned of all the dirt it may be carrying. The fluid used (10) may be any of the ones commonly used for this end, and does not require any particular type, with an optimum temperature for this degreaser being between room temperature and 90°C, with a time between 30 and 180 seconds.

The degreasing will be done with neutral emulsives, detergents or preferably by slightly alkaline degreasers. This stage can be done by immersion in the tank (1), whilst wound on the drum (6) or alternatively through projecting these fluids onto the cable (8) as a process prior to or instead of degreasing through detergents.

The cable goes on its way, leaving the first stage (1) and being drained (11) by blowing, by absorption or by any known method etc., then going on through elements which keep it taut, guided at all times by means of pulleys (9), rollers etc.. It then reaches a second washing container (2) where it is rinsed to remove any possible remains of dirt or degreasing agent from the previous stage.

This second washing stage can be replaced by a fine shower or spray which would obtain the same results, but eliminating one container (2) with its corresponding cylinder (6). In either of the two cases the residues from this washing stage are biodegradable so that this is not a source of contamination.

The following neutralizing stage (3) makes sure that there are no traces of degreasant left, using any fluid with this function for this purpose. There are also one or several cylinders (6) in this stage which, as in previous steps, are what the cable is wound around in the bath.

These neutralizing materials can be dilute acids such as nitric, hydrochloric, sulphuric acids etc., or acid salts of the right concentration and nature.

In the fourth stage there is a chromate bath (4). This bath or treatment is preferably done with chrome 3 (Cr^{+3}) or chrome 6 (Cr^{+6}) depending on the

characteristics required.

5 Chrome 6 gives considerably greater resistance to corrosion than that provided by a chrome 3 coating, but there are nevertheless companies which do not allow chrome 6 on their mechanisms, and thus the possibility of using either of the two compounds is taken into consideration. The temperature should be between room temperature and 40°C, with proportions of chrome 6 of from 1 to 10 g./litre and a pH of 1 to 2.5 with a time for this stage of 10 to 120 seconds.

10 In the event that a bath is changed from using Cr^{+3} to Cr^{+6} or vice versa, all that has to be done is to carry out proper cleaning of the tank or container (4) of the chromate and add the desired fluid. The process could also be done with two cables, so that one comes out of the neutralizing stage to the Cr^{+3} tank and the other cable from the same neutralizing tank to the Cr^{+6} tank, thus obtaining two
15 cables with one sole procedure, each one with a different kind of anticorrosive coat.

After the chromate stage (4) the cable is drained (12) in a process identical to the previous draining (11) at the exit of the degreasing stage (1). After draining it
20 goes on to a drying stage (13) where the damp that could be present on the cable after these baths is almost instantaneously eliminated by means of heating with air blast or preferably by induction.

The following stage is the sealing (5) where the cable wound onto the double
25 slotted cylinder (6) is inserted into a hot water solution between 60 and 80°C of silicate compound, which reacts with the chromate layer in an alkaline medium and to concentrations between 10 and 50 g/litre and pH between 10.5 and 12, forming a complex of zinc chromate and silicon (SiO_2) which make up the definitive anticorrosive layer when dry in the next stage. The time taken for this
30 stage varies from 20 to 240 seconds.

All the chrome-silicon remains in the treatment, there being no waste or contamination and so it is not necessary to have expensive installations for this purpose, as chrome is highly contaminating.

The last step in the procedure consists of draining (12) and drying (13) of similar characteristics to the tanks in the previous step (12 and 13).

5 This anticorrosive layer is formed by a microcrystalline layer based on zinc, iron, chrome and silicon which to a large extent prevents the formation of corrosive rust on the base metal even with large mechanical stresses in corrosive atmospheres.

10 Later on, depending on the stresses to which the cable will be subject, a lubrication stage is advisable or not. If the cable has to withstand abrasion in its work or friction through twisting of the cable, either thread against thread, against pulleys, guides etc., then this last lubrication stage should be included. The cable would go on to a following tank (18) in which the oil would be applied by aspersion or immersion with the temperatures and for the times according to
15 its function, then collecting the oil not impregnated.

This lubricant could preferably be molybdenum sulphide although others could be used, either organic or synthetic types suitable for these functions.

20 Finally, in the event that lubrication is applied, a last draining and drying stage would be included.

25 During the chromate stage, with chrome 3, a compatible colouring agent of aniline type could optionally be added, also in the silicon solution, which would result in a slight dying in any colour or shade which would identify the process, blue, green or red being the most suitable. This colour does not affect the chemical reaction or the final results.

30 After all this treatment, the cable would be coiled again after treatment for its marketing and use.

The speed of the cable's movement through the process in a continuous procedure would normally be constant, the time it stays in each bath or stage depending on the number of turns that the cable is wound around the drum (6) in

each stage. The speed of this pull would be adjustable and conditioned by each particular case, depending on the base metal, anticorrosive coating required and diameter of the cylinders. The drawings show the reels (6) which are normally inside the bath in the tank. The cable (8) is wound around these reels the number of turns proportional to the length of stay in each bath.

The reels (6), like the other elements, are secured to a structure that is vertically moveable for inserting or removing the reels into or from the relevant bath.

The cable comes out tangentially towards a drainer (22), a pulley (23), on whose cable a further pulley (24) rests, with a counterweight (25), a lever arm (26) joined to a bar (27) which acts as a connecting rod/handle with the rod or arm (28), on top of which there is a detector (29) for sensing changes in distance which sends a signal to the motor (30) which drives the reels.

The system has a very simple operation, which works as follows: when the process starts all the motors (30) are switched on at the same time, at the beginning all turning at the same time so that the cable (8) is synchronized in each of the stages.

There will preferentially be a motor device for each set of reels used in each stage of the process.

This movement gives rise to a slight tug on the cable which unwinds from its reel for treatment. This cable (8) is wound round the coils of the reels (6) in the corresponding bath.

The cable (8) comes off the top reel tangentially and heads towards the tube (22) inside which an air draught is blasted onto the cable, making any liquid held on it fall into the same tank from which it started.

After this draining tube (22) it goes over a pulley (23) towards the reel for the next bath. In said section a pulley (24) is placed to rest on the span of the cable (8) between the pulley (23) and the next reel (6).

This pulley (23) could be any detector of the tautness of the cable (8) at this point. Said tension detector (24) is linked with an arm (26) linked in turn to a bar (27) which can turn on its axis.

- 5 This arm (26) can have a counterweight (25) fitted to regulate the required tautness of the cable.

When for any reason the cable (8) becomes slack, the tension detector (24) will move, in this case downwards, through the effect of the counterweight (25) causing a turn of the connecting rod handle (9, 10) making the rod or handle device (28) turn, so that there is a variation in the relative position of its surface (31) in respect of the (preferably analogical) detector (29), sending a signal to the motor (30) for tension reduction, which results in a reduction of its turning speed, until the tension in the cable becomes correct again; the pulley (24) goes up giving rise to a turning torque on the arm (26), the bar (27) and the handle (28) so resulting in the same relative position with the detector (29) cutting out the signal which it sent for tension reduction to the motor (30), this then turning again at the original speed.

- 20 The same thing happens when the cable (8) becomes too taut, but the other way round. That is, the movement of the arm (26), bar (27) and rod (28) is in the opposite direction, making the detector (29) send a signal to the motor (30) which accelerates until the excessive tautness of the cable (8) disappears.

- 25 This device should be fitted for each set of reels used for each stage or bath in the process.

This treatment is suitable (and also multiplies the anticorrosive effect) for application on drawn wires with electrodeposition of zinc alloys, such as zinc-iron, zinc-nickel, etc..

This treatment is furthermore perfectly appropriate for discontinuous processes in which the hollow spools of drawn cable with residual zinc layer, galvanized or zinc treated are submerged in the different stages by means of transfer machines

or similar, allowing the relevant chemical reactions which give the
aforementioned anticorrosive properties.

- 5 After describing the nature of this invention, as well as one way of putting this
into practice, we need only add that as a whole and as regards the parts that
make this up it is possible to introduce changes in form, materials and layout, on
condition that said alterations do not substantially vary the characteristics of the
invention as claimed below.



1. Procedure for anticorrosion treatment for braided cables, starting from a thread of base metal covered with a layer of zinc, characterized in that the process after the braiding and drawing consists of stages of degreasing, washing, neutralizing, chroming, washing, sealing and drying, with this procedure being valid both for continuous and discontinuous installations.
2. Procedure for anticorrosive treatment for braided cables, according to the first claim, characterized in that for continuous treatments the second washing stage can be replaced by a draining and/or drying step.
3. Procedure for anticorrosive treatment for braided cables, according to earlier claims, characterized in that the draining, either by blowing or mechanical methods of absorption or others known of, the excess material goes back to the unit from which it started, thus not giving rise to any loss of material.
4. Procedure for anticorrosive treatment for braided cables, according to the first and second claims, characterized in that the drying will consist of the evaporation of water which is contained by the surface layers of the cable without these layers coming off, preferably using a system of induction, forced air or any known method for this end.
5. Procedure for anticorrosive treatment for braided cables, according to the first claim, characterized in that after the last stage a later lubrication stage can be applied, depending on the work that is to be done by said cable, with the oil used preferably being based on molybdenum sulphide or other organic or synthetic oils suitable for this function.
6. Procedure for anticorrosive treatment for braided cables, according to the first claim, characterized in that the cylinders, reels or known system used in the corresponding stages for winding the cable into each bath consist of a series of slots set out in the turning direction of the drum.



7. Procedure for anticorrosive treatment for braided cables, according to the first and sixth claims, characterized in that the time the cable stays in each bath or stage is determined by the number of turns this cable makes over the slots of the corresponding cylinder.

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8. Procedure for anticorrosive treatment for braided cables, according to the first claim, characterized in that the continuous process has a constant speed stemming from the fact that the cable is pulled from the end, crossing the different tanks and running through the channels in the reels or cylinders.

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9. Procedure for anticorrosive treatment for braided cables, according to the first claim, characterized in that in the chromate stage, with chrome 3, a cable dye can be applied without affecting the chemical reaction or the final results.

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10. Procedure for anticorrosive treatment for braided cables and pulling system, characterized in that a pulling system is included in the process, consisting of a cable tension or tautness detector on the way onto each reel in each stage. Said detector has an adjustable tension regulator, an arm with connecting rod and handle, a detector of changes in relative position in respect of the handle piece so that any variation in this relative position gives rise to the emitting of a signal to a motor which varies its speed in response to said signal until the tension of the cable is corrected.

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11. Procedure for anticorrosive treatment for braided cables and pulling system, according to previous claims, characterized in that each stage or bath has a regulating device independent of the others, which means that the regulation of cable tension is carried out by changing the speed of the motor in the relevant stage where the difference in cable tension arises.

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