CLAIMS

1. A method for treating a part (P) made of ferrous metal, comprising:
   - a nitriding operation forming on the part (P) a combination layer (2) having a thickness of between 5 µm and 30 µm, and a diffusion region (3), arranged beneath and in contact with the combination layer (2), having a thickness of between 100 µm and 500 µm; then
   - an operation of quenching the part (P) by high-frequency induction performed in such a way that ferrite is conserved in the part (P) between the diffusion region (3)/combination layer (2) interface and at a depth of 500 µm, preferably between the diffusion region (3)/combination layer (2) interface and at a depth of 300 µm, over an induction depth that is greater than or equal to 0.5 mm, thereby hardening the part (P) and lending said part (P):
     - a surface hardness greater than or equal to 50 HRC,
     - a hardness of the combination layer (2) greater than or equal to 400 HV0.05,
     - a hardness of the part greater than or equal to 500 HV0.05 at a depth of 500 µm,

   and wherein the high-frequency induction quenching operation is performed without the application of a protective film on the part (P) prior to the induction quenching operation.

2. The method as claimed ***in claim 1, characterised in that*** the induction quenching operation is not followed by a tempering operation.

3. The method according to any one of the preceding claims, ***characterised in that*** the operation of quenching the part by high-frequency induction is performed in such a way as to have a residual ferrite content in the part (P), between the diffusion region (3)/combination layer (2) interface and at a depth of 500 µm, of between 1% and 50% by volume, preferably between 1% and 30%, and more preferably between 5% and 30%.

4. The method according to any one of the preceding claims, ***characterised in that*** the operation of quenching the part by high-frequency induction is performed in such a way as to have a residual ferrite content in the part (P), between the diffusion region (3)/combination layer (2) interface and a depth of 500 µm, of between 5% and 20% by volume, preferably between 5% and 15%.

5. The method according to any one of the preceding claims, ***characterised in that*** it further comprises an impregnation step subsequent to the high-frequency induction quenching operation.

6. The method according to claim 5, ***characterised in that*** it provides the part (P) with a corrosion resistance that is greater than 80 h, according to a neutral saline spray test.

7. The method according to any one of the preceding claims, ***characterised in that*** the high-frequency induction quenching operation is performed with the following parameters:
   - a frequency (F) of 50 to 400 kHz,
   - a linear energy (E) of 4.6 to 5.8 J/mm.

8. A nitriding part (P) made of ferrous metal, comprising a combination layer (2) having a thickness of between 5 µm and 30 µm, and a diffusion region (3), arranged beneath and in contact with the combination layer (2), having a thickness of between 100 µm and 500 µm, said part (P) having:
   - a surface hardness greater than or equal to 50 HRC,
   - a hardness of the combination layer (2) greater than or equal to 400 HV0.05,
   - a hardness of the part greater than or equal to 500 HV0.05 at a depth of 500 µm, said part (P) comprising ferrite and martensite between the diffusion region (3)/combination layer (2) interface and a depth of 500 µm.

9. The part (P) according to claim 8, ***characterised in that*** the hardness of the part (P) at a depth of 0.5 mm is greater than or equal to a core hardness of + 100 HV0.05.

10. The part (P) according to claim 8 or claim 9, ***characterised in that*** the hardness of the part (P) at a depth of 0.25 mm is greater than or equal to a core hardness of + 350 HV0.05.

11. The part (P) according to any one of claims 8 to 10, ***characterised in that*** it is made of very low-alloy steel, of the C10-C70 family, having a manganese content less than 1%.

12. The part (P) according to any one of claims 8 to 11, ***characterised in that*** it comprises ferrite and martensite between the diffusion region (3)/combination layer (2) interface and a depth of 300 µm.

13. The part (P) according to any one of claims 8 to 12, ***characterised in that*** it comprises a ferrite content, between the diffusion region (3)/combination layer (2) interface and a depth of 500 µm, of between 1% and 50% by volume, preferably between 1% and 30%, and more preferably between 5% and 30%.

14. The part (P) according to any one of claims 8 to 12, ***characterised in that*** it comprises a ferrite content, between the diffusion region (3)/combination layer (2) interface and at a depth of 500 µm, of between 5% and 20% by volume, preferably between 5% and 15%.

15. The part (P) according to any one of claims 8 to 14, ***characterised in that*** it has a corrosion resistance that is greater than 80 h, according to a test using a neutral saline spray.