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Considerations Regarding the Opportunity of Using Psychological Techniques to Stimulate Solutions Characterized by Novelty and Inventive Step in TISR Transformers and Electric Motors with Shorted Moving Coil

This paper presents the appreciations and contributions regarding the use of psychological techniques to stimulate technical creativity with special reference to consonant association technique and inversion technique. The study is performed in the field of TISR transformers and electric motors with limited movement, starting from the analogy between a transformer and an electric motor with shorted coil. It approached a particular aspect of inversion technique in relation with the transformation of negative effects and results of laws, phenomena and processes into useful applications. The matter reffered to is related to the question: ,,why disadvantages and no advantages ?". At the end of the paper are presented and discussed some experimental models produced and studied by the authors in the Research Laboratory of Machines, Equipment and Drives at the University of Suceava and are exposed conclusions drawn from the experimental study and directions for future research.

Keywords: inversion technique, consonant association technique, electric motor with shorted mobile coil, electric motor with limited movement

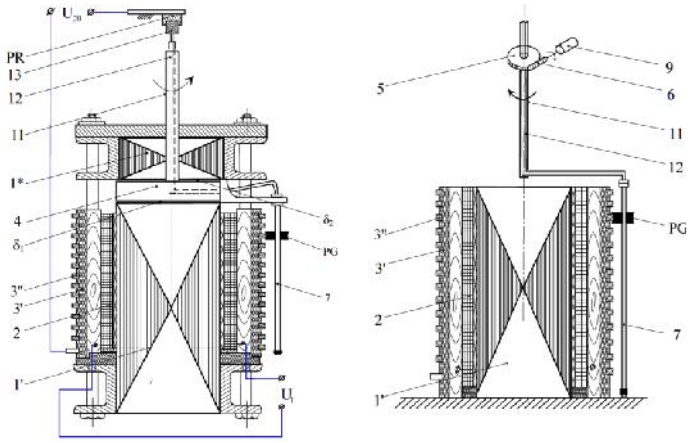
1. General aspects of continuously adjusting the voltage

The sources for automatic control of voltage can be classified as [4], [13]:

- sources with sliding contacts moving from one spiral to another;
- sources with sliding contacts constantly pursuing helical secondary winding path.

Regarding the adjustable sources where contact is constantly seeking helical path of the secondary winding conductor, the literature indicates two variants:

- the adjustable sources where the secondary coil is fixed and the sliding contact together with the guide support are rotated around the coil (figure 1);
- the adjustable source where the secondary coil is rotated and the axis of sliding contact together with guide support remains immobile.



a) b)

Figure 1. Sliding contact used in a transformer for continuous modification of voltage under load [4, 13]; a - cross section through the transformer; b - detail on the location and composition of the collecting system;
1' - central column magnetic system; 2 – fixed primary coil; 3' – insulating cylindrical support; 3'' – strip conductor of the secondary coil; 4 – ferromagnetic disc; 5 – ring gear; 6 – pinion; 7 – vertical arm guide; 9 – electric motor; 11 – hollow shaft; 12 – insulated wire; 13 – rotating conductors piece; δ_1, δ_2 – gap; PG – sliding brush; PR – rotating brush

Rotating secondary coil version was invented in 1929 by German engineer Hans Thoma (see figure 2).

The principle of operation is suggested in the table of components associated with the figure. On the central column of the magnetic core 1 is mounted concentrically a primary fixed coil and a secondary rotating coil made of insulating cylinder, on the surface of which is placed a strip conductor according to a helical path. To the upper part of the magnetic system, on the gap between the extremity of the central column and the upper front yoke is placed an insulating disc mounted jointly with the secondary coil which is traversed by a connection that crosses the upper front yoke, being connected to a collector disk surface which tread a fixed brush collector. The connection placed inside of the insulating disc connects the upper end of the rotating coil and the fixed brush and is driven in

rotation through a gear wheel asociated with a pinion, located at the end of the threaded spindle drive which acts on a movable brush, which is permanently in contact with the helical path of a rotating secondary coil. Voltage, continuously adjustable, is collected from the two brushes, one fixed and one mobile [4], [13].

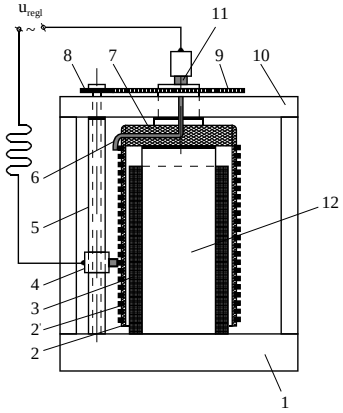


Figure 2. Adjustable source which secondary coil is rotating [13]
1 – magnetic system; 2 – mobile insulating cylindrical support; 2' – strip conductor of rotating secondary coil; 3 – primary fixed coil; 4 – mobile contact brush; 5 – drive screw shaft; 6 –mobile connection placed in the air gap between the column and the upper front yoke; 7 – electroinsulating disk jointly and severally liable with rotating secondary coil; 8 – pinion; 9 – gear wheel; 10 – upper front yoke; 11 –fixed brush contact; 12 – column system.

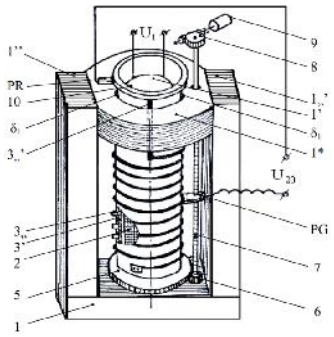


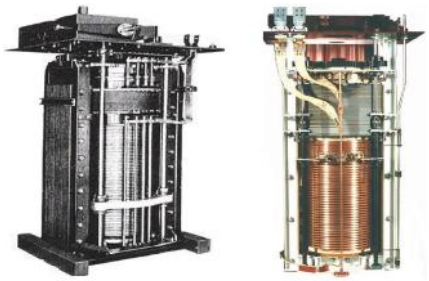
Figure 3. Adjustable source witch the secondary coil is turned around its axis [4, 13]
1 – magnetic system; 1' – central column; 1'', 1''' – lateral yokes; 1* - upper front yoke; 2 – fixed primary coil; 3' – electroinsulating cylindrical support; 3'' – strip conductor; 3''' – upper end of the secondary coil; 5 – ring gear; 6 – pinion; 7 – drive shaft; 8 – scaler; 9 – electric motor; 10 – colector ring; δ – gap; PG – sliding brush; PR – rotating brush.

An improved version of the solution shown in figure 2 is displayed herewith in Figure 3.

Commercial versions of this last constructive solutions are shown in figure 4.a, Hafeley company model, and in figure 4b, Phenix Technologies company model.

The disadvantage of the solutions presented in figures 2 and 3 consists in the gap in witch it evolves mobile connection that connects the upper end of the rotating coil and the fixed brush. The presence of the air gap leads both to increasing of the load current (magnetization component) and to decreasing of the power factor.

The purpose of the authors of this paper is to identify the constructive solution to allow the use of a magnetic system without gap.



a) b)

Figure 4. Electric transformer that sliding contact permanently seeking the helical path of the secondary coil [4, 13]
a – model manufactured by Hafeley company; b – model manufactured by Phenix Technologies company.

2. General consideration on psychological techniques of creation

"The study of the factors influencing the technical creativity highlights the fact that creative process is hampered by a number of psychological, gnosiological, educational, technical and organizational factors.

Among the psychological barriers, psychological inertia characteristic of inflexible minds have a special importance and is based on human intellect who tend to preserve unchanged schemes of rational thinking, solving methods, the tendency to always go the verified way." Starting from the correct observation that a psychological barrier can be eliminated or reduced all the psychological way, researchers in this field have developed a series of creative techniques and psychological methods of creation. [1], [2], [3].

This paper aims to present some reflections and some contributions from the authors about the inversion technique.

"It is known that the stereotypical approach of problems in designing often leads to sterility of ideas. But changing the angle of approach for solving the proposed theme, you can reach the reduction or elimination of psychological barriers.

Inversion technique can lead to these results using questions such as: ,, ... which are the opposites? ... why would not replace the positive with the negative? ... why from bottom to top and not from top to bottom? ... why not horizontal but vertical? ... why not starting with the end in place to deal with at the beginning? ... why from general to particular, and not vice versa? ... why not be located at the opposite end?". [1], [2], [3]

The paper is approached with a particular aspect of this technique referring to the transformation of negative effects and results of laws, phenomena, processes, facilities and electrical devices in useful applications. In a more concise form, that issue is related to the question: why

disadvantages and no advantages? Electrical fields provide sufficient examples in this direction.

3. Contributions to stimulate solutions for achieving continuous adjustment of voltage transformers

Regarding consonant association technique, is suggestive personal example rendered by one of the authors of this article: ,,During time of reflections about finding a solution to the collector system of a transformer with secondary rotating coil achieved without cutting magnetic system, he was in front of a damage of electric power transformer 10 MVA; 10/6 kV. After the priming of the electric arc between the end of the winding wire of 10 kV and the outside front yoke, the sheets thereof have been involved in the creation of a conductive path between the said coil and the magnetic parts of the system connected to the ground. The temporarily engaged yoke front surface of the circuit was partially melted, resulting in a failure shown in figure 5.

Figure 5. Fault of a transformer 16 MVA; 10/6,3 kV [7]

In connection with this image, appeared first association with catalyst consonant criterion of the yoke laminations. As a result of this consonant association appeared idea for a technical solution in which the yoke laminations are involved in carrying out the transfer of the collector circuit of the current collecting brush integral with the lower end of the rotating coil, and a plate collector located on the lower surface of the lower front yoke, and contact with each of the laminations of composition yoke. Basically this solution is shown in figures 6.a and 6.b

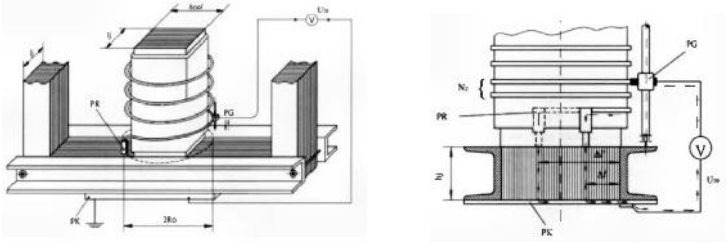


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Figure 6. a – principled exposure of collector system by yoke laminations; b – explanatory route planning conductor through yoke laminations [4]

The experimental model for this solution is shown in figure 7, in which is presented a rotating transformer secondary winding (TISR) with collector system with yoke laminations.

The solution suggested by the damage shown in figure 5 and exposed principled in figure 6 could be identified by applying with particular character, the inversion technique seeking an answer to the question: ,,How can we transform negative effects and adverse outcomes of phenomena and processes laws, installations or devices in useful applications?". In a more restricted form, that issue is related to the question: ,,Why disadvantages and no advantages?".

In connection with the studied appearance an outstanding importance has the modification-improvement-development technique. Applying this technique involves formulating answers to questions like: ... what can change? ... what can improve? ... what can develop? ... whose elements can change the shape and size? ... how to reduce weight? ... how to improve commercial aspect? ... what can be added? ... what can multiply? ... what can reduce? ... what can replace and wherein?

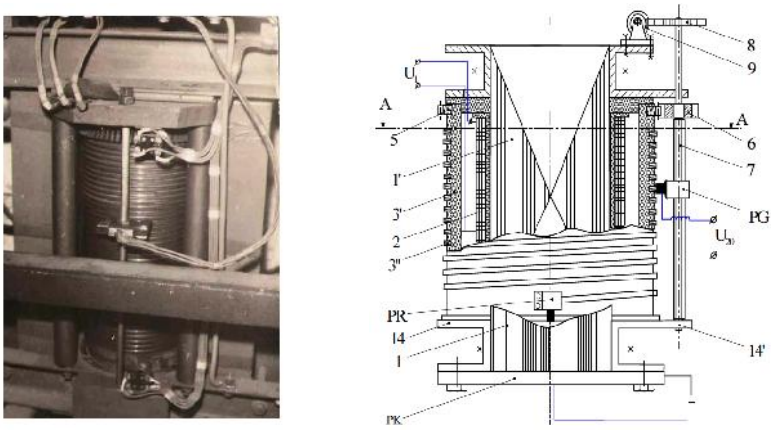

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Figure 7. TISR with collector system with yoke laminations [5]
a – experimental model; b – explanatory experimental model
1 – magnetic system; 1' – central column; 2 – fixed primary coil; 3' – insulating cylindrical support; 3"' – strip conductor of the secondary coil; 5 – ring gear; 6 – pinion; 7 – drive shaft; 8 – scaler mechanism; 9 – electric motor; 14, 14' – beam yoke; PR – rotating brush; PG – sliding brush; PK – plate collector

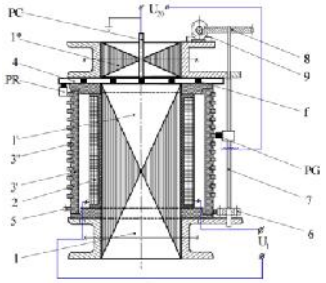
a)   b)

Figure 8. TISR and ferromagnetic disk with slots [5, 6]
a – experimental model; b – explanatory experimental model
1 – magnetic system; 1' – central column; 1* – upper front yoke; 2 – fixed primary coil; 3' – electroinsulating cylindrical support; 3'' – strip conductor of rotating secondary coil; 4 – ferromagnetic disc collector with slots; 5 – ring gear; 6 – pinion; 7 – drive shaft; 8 – scaler; 9 – electric motor drive; f – slot; PC – plug collector; PG – sliding brush; PR – rotating brush.

On the basis of the modification-improvement-development technique was obtained the solution TISR with ferromagnetic disk with slot (see figure 8), the solution TISR with collector system with involute laminations column (figure 9), and the solution TISR with collector disc with twisted laminates in evolvent (figure 10).

Then based on analogy and extrapolation technique was developed, realized and experienced solution TISR with collector disc with twisted laminates in evolvent (figure 11).

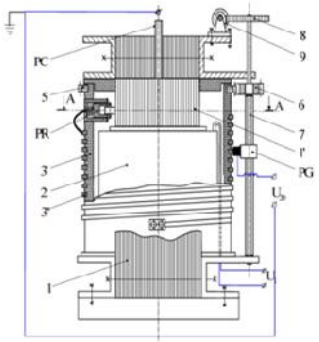
a)   b)

Figure 9. TISR with tole collector system of the involute column [5]
a – experimental model; b – explanatory experimental model.
1 – magnetic system; 1' – central column; 2 – fixed primary coil; 3' – insulating cylindrical support; 3'' – strip conductor of rotating secondary coil; 5 – ring gear; 6 – pinion; 7 – drive shaft; 8 – scaler mechanism; 9 – electric motor drive; PC – plug collector; PR – rotating brush

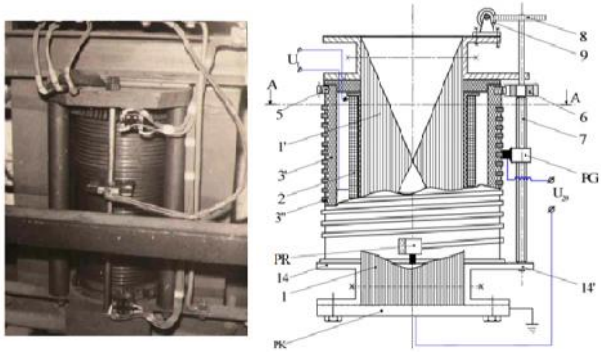
a)  b)

Figure 10. TISR with collector system with a yoke plates [5]
a – experimental model; b – explanatory experimental model.
1 – magnetic system; 1' – central column; 2 – fixed primary coil; 3' – insulating cylindrical support; 3'' – strip conductor of rotating secondary coil; 5 – ring gear; 6 – pinion; 7 – drive shaft; 8 – scaler mecanism; 9 – electric motor drive; 14, 14' – beam yokes; PG – sliding brush; PR – rotating brush; PK – plate collector

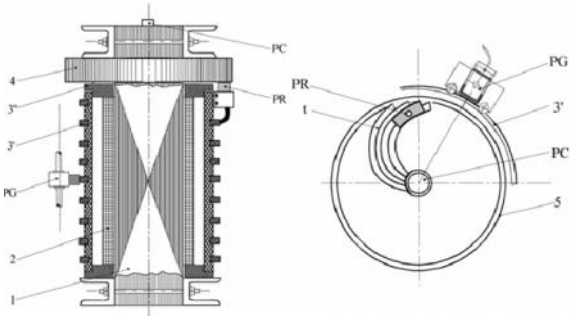


Figure 11. TISR with collector disc with twisted laminates in evolvent [13]
a – cross-section; b – detail. 1 – magnetic system; 2 – fixedprimary coil; 3' – insulating cylindrical support; 3'' – conductor of secondary rotating coil;4 – collector disc with twisted aminates in evolvent; 5 – clamping ring; t – involute laminate; PC – plug collector; PG – sliding brush; PR – rotating brush

3. Contributions to the development of limited movement engines and motors with moving shorted coil

The starting point in identifying new solutions in the specified domain was also the consonant association technique. Many years before, one of the authors of this work was found in front of the spectacular failure in case of power transformers and high voltage and were subjected to impressive electro-shocks results following short circuits between coils due to insulation

penetrations (figure 12 and figure 13).

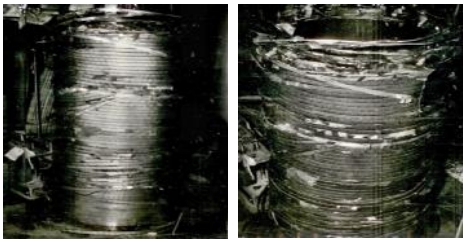


Figure 12. Fault of transformer of 1600 kVA, 20/0,4 kV [7]

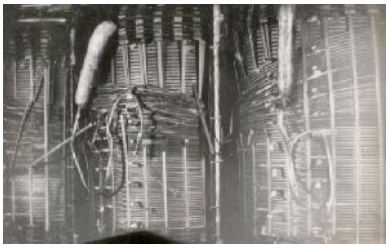


Figure 13. Fault of a transformer of 40 MVA, 110/6,6 kV [7]

Upon contact with the above faults, the authors was already connected to the incubation stage looking for a solution for a powerful, high speed and low dimensions electric motor. During reflection on this issue, the contact with the two failures contributed to a first association geared catalyst powerful forces developed between the winding shorted turns and the effect of these forces on the integrity of the insulation and the conductor itself. The association consonant has led to the suggestion made on the basis of the technical solutions of the linear electric motor with mobile short-circuit secondary coil (figure 14 and figure 15).

As in the previous case, the solutions could have come with the inversion technique seeking an answer to a question like: ... what are the contrary elements? ... why would not replace the negative with the positive? ... why disadvantages and no advantages?

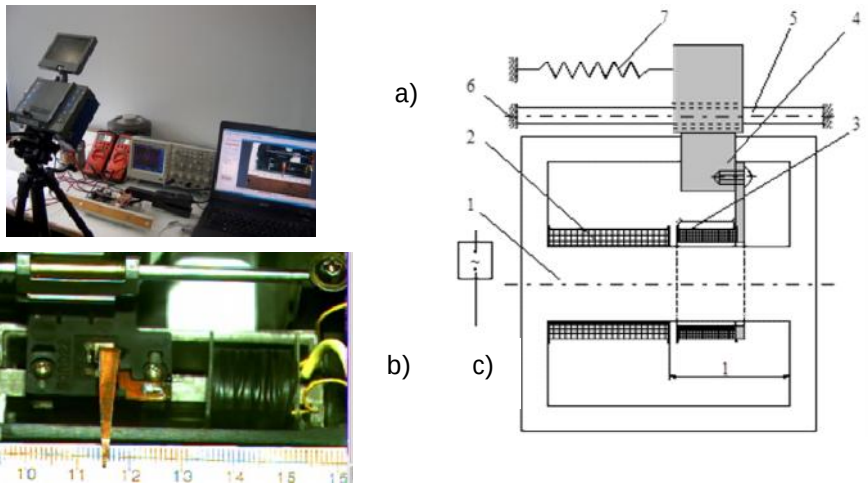


Figure 14. Liniar electric motor with shorted moving coil [9, 10]
a – wiring diagram of principle; b – experimental stand; c – detail view
1 – mangetic system; 2 – fixed coil; 3 – shorted mobile coil; 4 – slide; 5 – guide shaft; 6 – stopper; 7 – resort

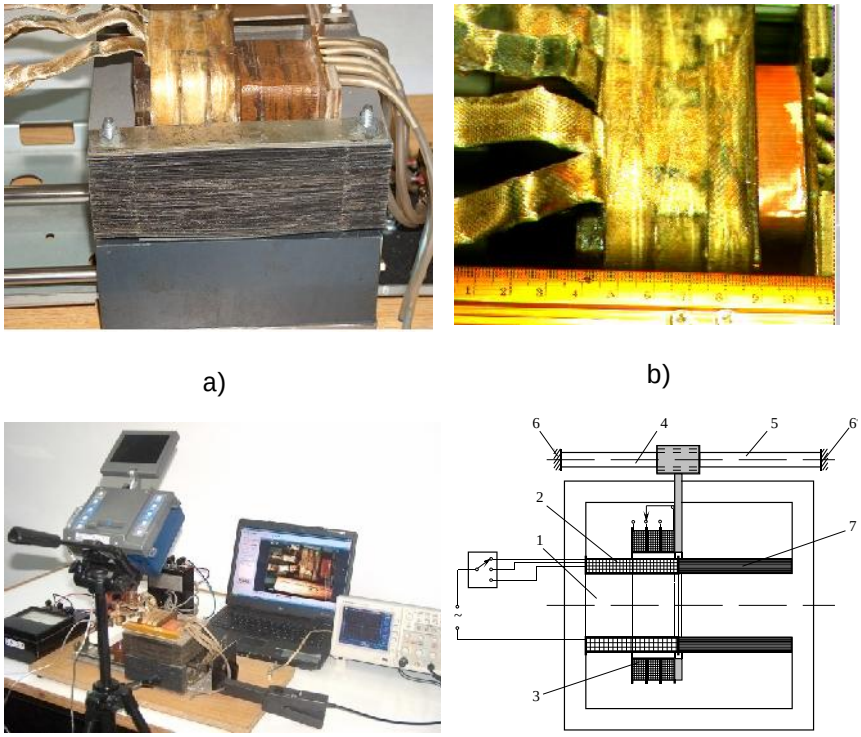


Figure 15. Liniar electric motor with shorted mobile coil with variable height [10]
a – general view; b – detail view; c – experimental stand; d – schematic diagram.
1 – magnetic system; 2 – fixed coil; 3 – shorted mobile coil; 4 - slide; 5 – guide;
6, 6' – stoppers; 7 – building electro-spacers; 8 – switch sockets

4. Conclusions

1. Within this article, attention was focused, especially on psychological techniques (intuitive) of creation in technique, in view of the possibilities offered for individual involvement of the creator, through the knowledge of psychological barriers and by applying specific methodologies to counter or mitigate. Given the foregoing facts, the authors have focused their efforts on making transformers with secondary winding rotor (TISR) and linear electric motors with shorted moving coil.

2. The psychological techniques studied and used in this paper to eliminate or reduce technical barriers and to stimulate the creation of solutions characterized by novelty, originality and applicability were consonant association technique, analogy and extrapolation technique and inversion technique.

4. Through the consonantiste conception, creation represents composing new ideas with available elements, establishing new consonances and new dissonances between images and ideas. In accordance with the consonantist concept, in the creative process, the primordial phenomenon is evocation, and its cause is similarity whose intensity is determined by the resonance (consonance).

5. Evocation is a psycho-dynamic phenomenon whose direction, purpose and selectivity are determined by consonance criteria. Evocation is the reproduction of an image caused by its likeness to a sensation, triggering its own specific vibrations in the brain or mental resonator by the mechanism found in unison with another excited resonator, is a fusion in the same vibrator rhythm of two disparate sensations through time and space or a formal motion of the related sensations. The ability for tunning and evoking is an incentive to initiate and conduct creative process.

6. The inversion technique is a great way to change the look and evaluate existing technical solutions that get used and that leads sometimes to consider them immutable. From this point of view, the inversion technique contributes to changing the angle of approach to the problems of creation, contribute to mitigating the psychological inertia. The paper is dealt with a particular aspect of this technique to the transformation effects and adverse outcomes of laws, phenomena, processes, facilities and electrical devices in useful applications. In a more concise form, that issue is related to the question: why disadvantages and no advantages?

7. In this paper, the technique of analogy and extrapolation based on borrowing ideas from the solution more or less close is another way to combat the psychological barriers: psychological inertia, low fluency, functional rigidity, lack of fantasy and imagination, lack of sensitivity to problems or toward to the up-to-date.

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