Bobifil

COIL WINDING MACHINES

INSTRUCTIONS AND MAINTENANCE BOOK

TENSION DEVICE FOR THICK WIRES

- GSP -

INDEX

1. CHARACTERISTICS

Work method	Non - inertia
Admissible Wire Diameter	0,30 a 2,50 mm
Type of container	Pots and spools
Maximum Diameter of the pot	315 mm
Maximum Length of the pot	315 mm
Maximum Nº. of tensioners on a column	1
Maximum Nº of tensioners on a frame	16

2. PRINCIPAL ELEMENTS OF THE -GSP- TENSION DEVICE

In Figures-1, 2 and 3 we can see the principal elements, which are referred to in the rest of these instructions.

On page, 5 there are the corresponding names and codes for any consultations or orders.

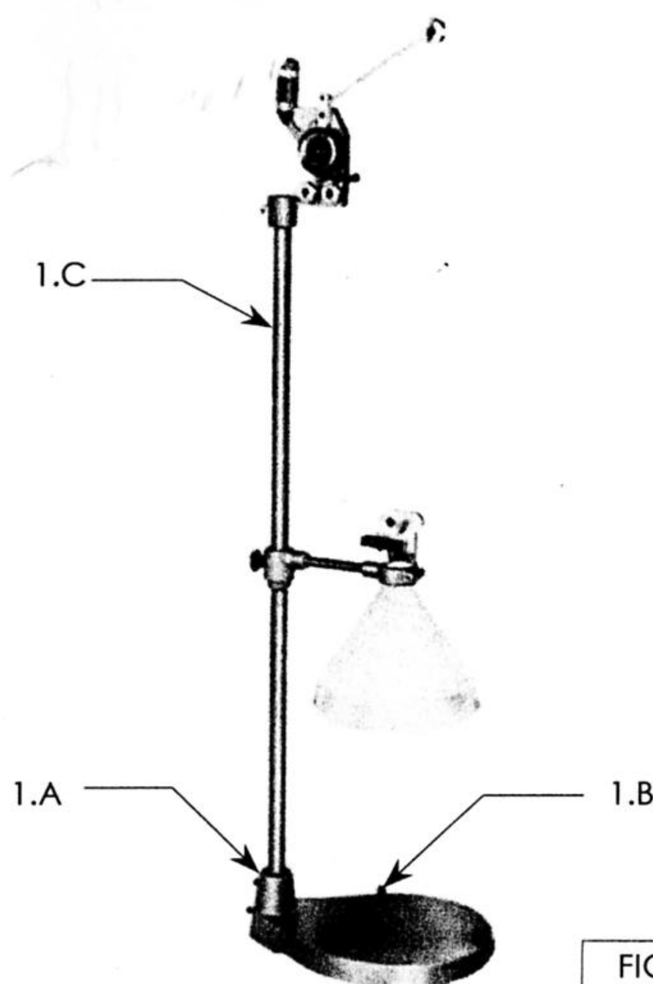
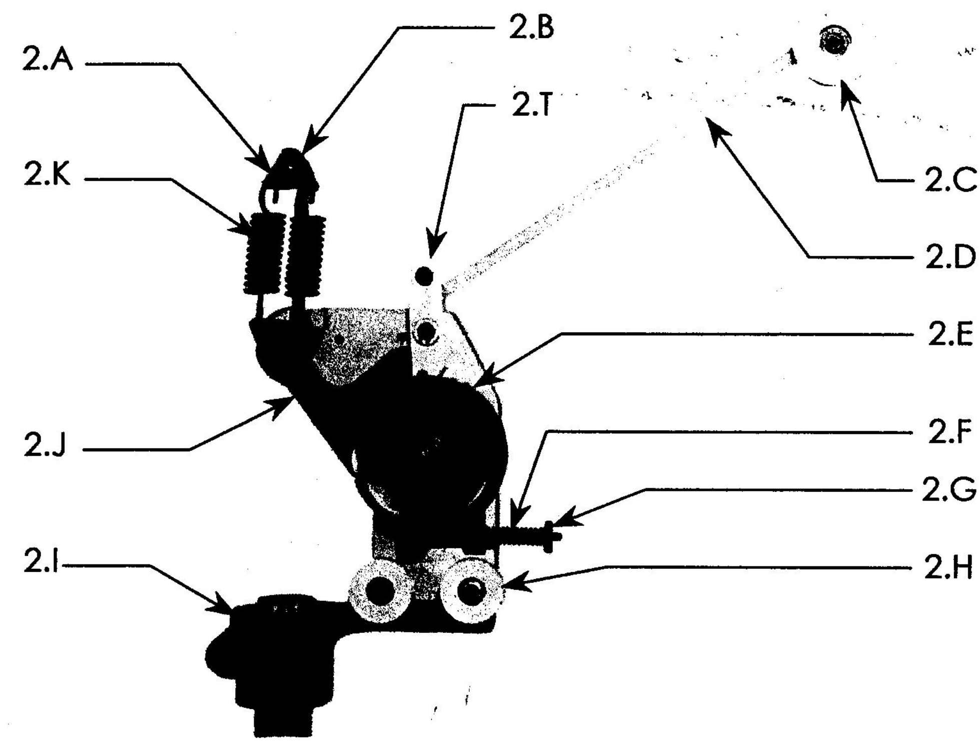


FIGURE - 1

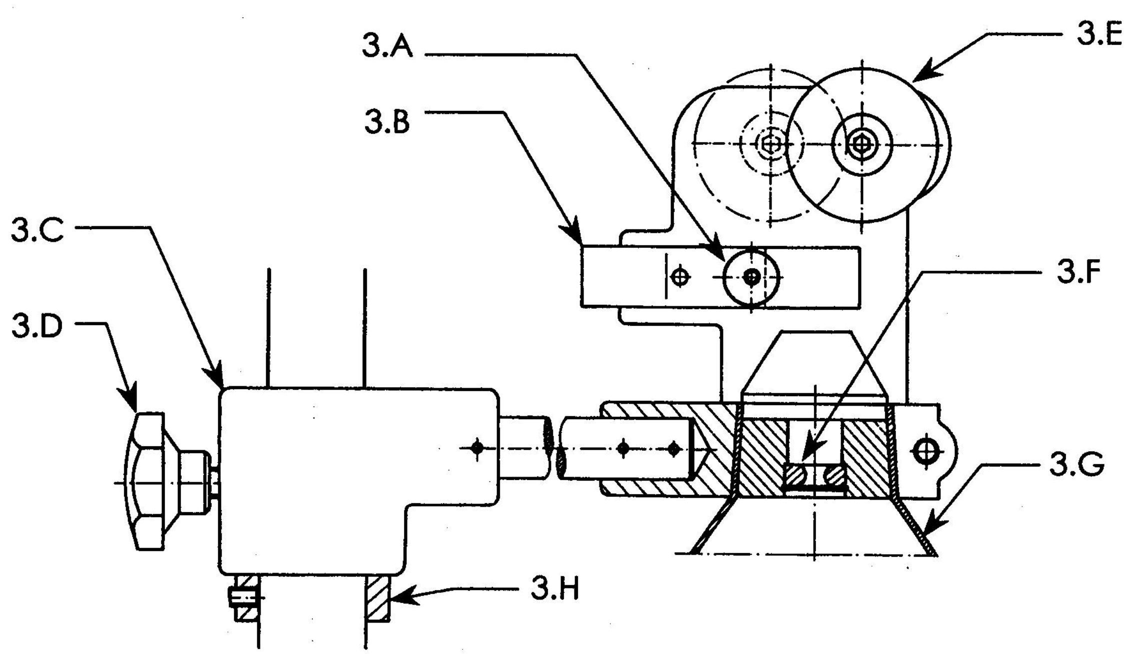
TENSION HEAD

FIGURE-2



FUNNEL SUPPORT

FIGURE-3



PRINCIPAL ELEMENTS OF THE -GSP- TENSION DEVICE

Reference	Description	Order N°.
1.A	BASE	7432
1.B	SITUATION PIVOTS	7433
1.C	COLUMN	7434

2.A	SPRING JOINER	7463
2.B	SPRING HOLDING PIN	7462
2.C	EXIT WHEEL	0647
2.D	OSCILLATING LEVER	7467
2.E	BRAKE PULLEY	7453
2.F	LARGE SPRING	7475
2.G	KNURLED BUTTON	7446
2.H	RECEIVING WHEELS	0566
2.I	SUPPORT	7449
2.J	LARGE SHOE	7456
2.K	SPRING	7464

3.A	KNURLED BUTTON	7446
3.B	FELT BRAKE	
3.C	SUPPORT BUSHING	7436
3.D	KNOB	7001
3.E	RECEIVING WHEEL	0647
3.F	WIREDRAW	7441
3.G	FUNNEL	7437
3.H	SUPPORT RING	7435

Any claims or orders for spare parts with respect to this tensioner must be accompanied by the corresponding Order Number indicated above.

3. COMPOSITION AND ASSEMBLY OF THE TENSION DEVICE

The GSP Tension Device is composed of a *Base -1.A-* over which is placed the *Wire Container Pot* between the *Situation Pivots -1.B-* and a *Column -1.C-* where the *Support -3.c-* of the *Funnel* and the *Support -2.I-* of the Tension Head, are located.

The *Support -3.C-* should be assembled at such a distance that between the upper edge of the *Wire Container Pot* and the lower edge of the *Funnel -3.G-* there are about 10 mm.

The Funnel -3.G- has a *Wiredraw -3.F-* to conduct the wire, a *Felt Brake -3.B-* and *Pulleys -3.E-*, which conduct the wire toward the Tension Head over the *Support -2.I-*.

Over the *Column -1.C-* and above the *Support -3.C-* of the funnel, there is the *Support -2.I -*. The height of this support is not critical and it shall conform to the winding machine.

The Tension Head (situated over the support -2.I-) contains a brake system activated by the *Oscillating Arm -2.D-*, which supports the *Exit Wheel -2.C-*.

From the *Supply Pot* the wire is conducted by means of the *Oscillating lever -2.D-* toward the winding machine. The oscillations in the tension of the wire that are produced by the winding, change the position of this lever which in turn acts on the brakes changing the intensity of the braking.

The large Shoe -2.J- only acts as a brake for the *Pulley -2.E-* when the machine stops. *The Small Shoe* situated in front of this is used to vary the intensity of the braking to produce constant tension in the wire.

In the working position, that is when the reeled wire moves the *Oscillating Lever -2D-* downward, the force of the traction spring acts on this as an opposing force to the force of the wire and by means of the *Small Shoe* regulates the braking of the same.

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i *When the machine stops, or if the wire breaks or if the container Pot should empty, the Oscillating Lever -2.D- jumps upward and the large Shoe -2.J- goes into action and brakes, stopping the rotation of the Pulley brake -2.E- ceasing the supply of wire.*

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4. PLACING THE WIRE CONTAINER POT

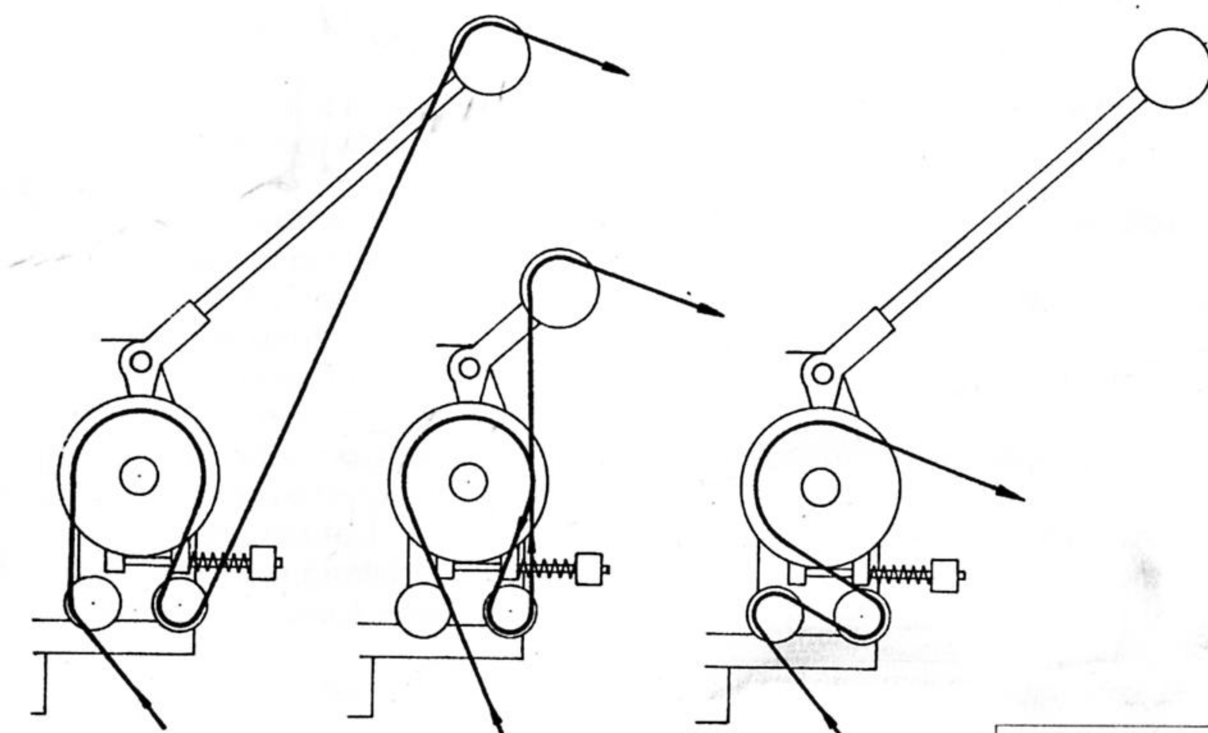
The *Wire container pot* is placed between the *Situation Pivots -1.B* after first loosening the *Knob -3.D-* and all of the *Bushing -3.C-* , is turned laterally. Once the pot is in place and before putting it back in the initial place, take the end of the wire and pass it through the middle of the *Funnel -3.G-* through the *Wiredraw -3.F-* and the *Felt Brake -3.B-*. Put the Funnel in the original position over the pot and tighten the *Knob -3.D-*.

5. THREADING THE WIRE THROUGH THE TENSION HEAD

In Figure-4, the different ways to thread the winding wire are shown, according to the diameter.

We shall see that the *Oscillating Lever* can be placed in different positions (by loosening the screw 2.T, Figure-2) according to the thickness of the wire.

The thickest wires will not be passed through the pulley of this lever.



WIRES FROM Ø 0,3 a Ø 0,7 mm. WIRES FROM Ø 0,5 a Ø 1,3 mm. WIRES FROM Ø 0,7 a Ø 2,5 mm.

FIGURE -4

In these operations, the Oscillating lever will be lowered by hand to free the Pulley brake -2.E- and thus be able to run the wire easily through all the pulleys.

6. REGULATING THE FELT BRAKE

The *Felt brake -3.B-* can be slightly tensed by tightening the *Knurled button -3.A-* until the wire pulls as it moves, on the *Pulley -2.E-*.

For this regulation the *Oscillating lever -2.D-* is lowered by hand to free the brake of the *Pulley -2.E-*. If the *Second shoe* should brake, loosen the *Knurled Button -2.G-* until it no longer brakes.

If in time the wire should slide over the Pulley -2E-, or if it is necessary to work with lots of tension, give a complete turn of the wire over this Pulley -2.E-.

7. REGULATING THE TENSIÓN OF THE OSCILLANTING ARM

This regulation is the most important. According to the diameter of the wire to be used, more or less tension is given to the oscillating arm. To do this, loosen the screw that holds the *Spring joiner -2.A-*, and by turning this forward or backward, more or less tension is applied. The maximum tension is achieved when the *Springs -2.K-* are perpendicular to the line which joins the turning shaft of the *Large Shoe -2.J -* with the *Holding Pin of the Springs -2.B-*. The minimum tension is achieved when the springs are in line with the points mentioned previously.

The tension given to the *Oscillating lever -2.D-* should never go beyond the point of tension of breaking the wire.

To graduate this tension, once the wire hàs been threaded as we explained previously, pull gently on the wire while holding the *Pulley -2E-* at the same time, so that it doesn't turn and the wire doesn't come out; pull on it until the oscillating lever reaches the end.

If the wire does not break, then more tension must be applied. In this manner, successive tests can be made with slightly greater tension each time.

While making this test, the moment will come when the wire will break, turn the springs back a centimeter and a half and tighten. Check once more that the wire does not break when pulled on.

This regulation is made with wires of less than 0.70 illímeters, since the necessary tension for larger wires to reach the breaking limit would be excessive and the tensioner cannot give so much. Therefore the wire must have sufficient tension so that it remains tense and the tensioner tight, but it is not necessary to reach the breaking point.

☞ ***More information on the "Wire tension" may be found in Sect. 10.1, Pg. 10***

8. REGULATING THE BRAKE OF THE SMALL SHOE

A prior adjustment is made with the *Knurled Button -2.G-* so that the shoe only brakes when the tensioner is in the resting position. The regulation is finished while the machine is functioning. To do this, a tensiometer is placed between the tensioner and the machine and the *Knurled button -2.G-* has to be tightened until the tensiometer shows 2/3 of the maximum winding tension. If there is no tensiometer on hand, the position of the *Oscillating lever -2.D-* will serve as an indication, as it should be working at an angle of 45° to the floor.

At start-up the oscillating arm must drop to situate itself rapidly in the working position and remain almost mobile, or with slight oscillations only, but never jumping about, as this indicates a poor regulation. When the machine is stopped the arm should rise to the resting position and the wire should remain tense.

9. MAINTENANCE

9.1 So that the mechanism of the tensioner will maintain automatically the tension required at any speed, attention must be paid to cleaning the accumulated dirt so that the *ball bearings and wheels* of the *tensioner and the guider* do not harden in the winding machine.

9.2 We must also watch closely the wear on the linings of the shoes and change them for new ones when the wear is very obvious.

9.3 With the continuous passing of the wire over the *Brake felts -3.B-*, these felts become very worn and do not brake adequately. When they are completely worn, they must be changed for new ones.

Do not use felts that are not supplied by Bobifil as otherwise we cannot guarantee that the tensioner will function correctly.

10. VERY IMPORTANT OBSERVATIONS FOR WINDING FINE COPPER WIRE

Due to the conditions that the bobbins must fulfill that are destined for electric or electronic equipment, the winding of copper wire on round or rectangular spools presents a series of difficulties, of which we should be informed to obtain bobbins in perfect condition.

10.1 WIRE TENSION

The wire should be wound with an optimum working tension, as otherwise the turns will move from their proper position in transport or due to the electrodynamic forces that arise when electrical current is sent through them.

This displacement by friction can cause peeling in the insulation and short-circuits between the turns; also, the wire will occupy more space and more meters of wire will be needed for the same number of turns.

Excessive tension on the wire can produce stretching, such stretching produces cracks in the insulation, and sparks can jump between the turns. It also causes a reduction of the section of the wire, and this in turn produces an increase in the resistance of the bobbin.

In the same manner, excessive tension can reach the point of producing wire breakage.

To correctly measure the tension, an apparatus called a tensiometer is placed between the tensioner and the guider while functioning, thus measuring the dynamic tension of the wire. In such cases where extreme precision is required in the tension of the wire, the use of this apparatus is imperative.

In the chart on the following page, we can see the different tensions required for each diameter of wire.

This chart is the result of many calculations and tests, and is used internationally by almost all of the manufacturers of tension devices and winding machines.

For wires larger than 2 mm. diameter we will apply an approximate tension of 4,7 Kg Per mm^2.

When various wires are wound at once the tension on the machine is the sum of the tensions of each one of the wires.

10.1.1 ADMISSIBLE TENSION FOR WINDING ENAMALLED COPPER WIRE

Nominal Diameter in mm	Winding Tension	
	Kg / mm²	Kg (Force)
0,30	8,00	0,565
0,35	7,75	0,746
0,40	7,50	0,947
0,45	7,30	1,160
0,50	7,10	1,395
0,55	6,95	1,650
0,60	6,80	1,925
0,65	6,70	2,220
0,70	6,55	2,520
0,75	6,40	2,830
0,80	6,30	3,170
0,85	6,20	3,520
0,90	6,10	3,880
0,95	6,00	4,250
1,00	5,90	4,630
1,10	5,72	5,435
1,20	5,60	6,340
1,30	5,50	7,310
1,40	5,53	8,220
1,50	5,19	9,200
1,60	5,06	10,200
1,70	4,94	11,200
1,80	4,85	12,350
1,90	4,77	13,500
2,00	4,70	14,750

YOU MUST NEVER WIND WITH HIGHER TENSION THAN THOSE THAT ARE INDICATED IN THIS TABLE

10.2 BRAKING THE WIRE WHEN THE MACHINE STOPS

For high speed work, and above all with very fine wires, there should be a balance between the braking of the machine and the braking of the tensioner, so that when the machine stops the wire will remain tense and without breaking.

To achieve this balance, we will have to control the different inertia that the wire is submitted to during the winding.

The brake of the machine must act by overcoming the inertia in such time the it creates a compromise between good production and the good conservation of the machine. The machine suffers more stresses, the more dramatic the braking, and the greater therefore the probabilities of breakdown. For this reason, the braking should not be greater than that which is strictly necessary.

The same should occur with the tensioner. If the braking of the machine is faster than the tensioner, when it brakes, the wire will continue to flow during a short space of time, until the tensioner brakes and therefore the wire will be loose. However, if the tensioner brakes more than the machine, this braking action will be produced in an elastic form, adapting itself at all times to the demands of the wire, which will remain overly tense.

To solve this problem, we must act on the brake of the machine to diminish the braking action and prolong the braking time.

This phenomenon appears at high speeds and especially with fine wires, which due to their lower tension have a longer braking time in the tensioner.

10.3 WINDING RECTANGULAR FORMS

When rectangular spools are to be wound that have a great difference between the measurement of the sides of the rectangle, and especially when winding with tapes or bands, very particular difficulties are encountered.

The speed of the wire is not always uniform as it is when winding circular forms; it produces a pulling effect of greater and lesser importance. The speed goes from zero to maximum two times per turn and this variation when multiplied by the rpm produces a frequency of jerks.

Since the function of the tensioner is to supply wire at constant tension, whatever variations that occur in the speed of the wire, the tensioner must have an inferior response time to the frequency of the jerks.
In practice, to obtain a winding with the turns correctly aligned, without overlapping and with the wire well tensed over the flat faces of the form of the spool, it is necessary that the proper frequency of response of the tensioner should be notably superior to the frequency of the impulses due to the winding of the band or form.

The proper frequency depends on the inertia of the oscillating pieces and the tension of the spring, that keeps them in their working position; thus it will be as high accordingly, to the greater the working tension.

This inconvenience exists inevitably with all types of tensioners and over the whole range of tensions, and is particularly uncomfortable in the lower levels of this range since the proper tension and frequency are lower.

In these working conditions the brake acts by producing a medium tension, as it does not have time to revert back and conform itself to the different tensions, and the elasticity of the wire must absorb these differences. Under these conditions the wire is not correctly pressed over the flat faces of the form, and the possibility exists that the wires may overlap in the turns and stretch excessively over the edges. This phenomenon is even more bothersome the greater the speed and the difference in size of the faces of the form.

If a perfectly aligned winding is desired, it is absolutely indispensable to work at such a speed that the frequency of the jerks is inferior to the proper frequency of the tensioner within a certain tension, or you can place a device for proper elevated frequency between the tensioner and the form, capable of liberating under almost constant tension a length of wire in the moment of passing the edges and storing it in the moment of passing the flat faces. This function can be carried out by a set of pulleys.

It has been observed that for a determined tension, there is an area of speeds where it is practically impossible to wind without breaking the wire when the amplitude of the pulling effect reaches a certain value.

On the other hand, the winding is possible at speeds superior to the ones in this area, which is therefore convenient to cross rapidly to avoid that the vibration phenomenon should come into resonance.

When increasing the speed the instantaneous dynamic tension of the wire also increases. Therefore it will be necessary to regulate the tensioner to an inferior tension than that desired. In certain cases, the wire that is situated between the tensioner and the guider starts vibrating forming a skipping rope effect that can produce wire breakage if it goes into resonance.

To avoid these vibrations, it is sufficient to place along the line of the wire, in line with the wire guide or any other support, a slight felt covered resting place for the wire.

From: "Bob Humphrey" <bobh@sarcem.com>
To: "Stan Cotreau" <cotreau@physics.harvard.edu>
Sent: Tuesday, September 27, 2005 2:21 PM
Subject: Our phone conversation

Stan,

You have our permission to reproduce the tensioner instruction manual, the machine maintenance manual, and the programming manual in electronic form for your use by students, faculty, and support personnel.

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