

OPEN WIRE  
STRINGING COPPER WIRE  
POINT TRANSPOSED

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1. GENERAL

1.01 This section describes the method of sagging and throwing transpositions in copper line wire to be point transposed for "J" Carrier operation.

1.02 The wires are to be strung and laid up on the crossarms as described in Section G31.110. Precautions to be taken during this work are given in Part 3 of this Section.

2. TOOLS

2.01 Tools not previously standardized for line construction which are required for this work are

(a) Ice Scale 500 lbs. capacity. (J. Chatillon and Sons, New York, No. 180 iron-clad or equivalent.)

(b) 1/8 inch diameter 6 x 19 stainless steel wire rope as required for wire pullers and equalizer.

(c) 1/8 inch galvanized wire rope thimbles.

(d) Pair oscillator (Figure 4)

(e) 5 inch single sheave roller bushed metal block for equalizer.

### 3. STRINGING WIRE

3.01 The points outlined in the following paragraphs should be considered before and during the wire stringing work.

3.02 The method described in this practice is most efficient in level straight sections of line. The line should be covered in advance of the actual work in order to select reel locations and plan material deliveries accordingly. In rough country where changes in grade or corners occur every few spans it will be necessary to use short stringing sections. Arrangements should be made to start a new section at or close to corners or points of abnormal changes in grade. When necessary to include such points in a run they should occur within a few spans of the start so that the added friction introduced in pulling slack around these points will be eliminated for the greater part of the section. When a one or two pole corner is the dividing point between two stringing sections sufficient wire should be left at the end of the run to go around the corner and join the next section.

3.03 The stringing sections should terminate where other conditions are favorable two poles beyond storm guyed H fixtures, or other structures where the crossarms are reasonably rigid for temporarily dead ending the wire. Otherwise it may be necessary to temporarily guy the crossarm on which the wires will be temporarily dead ended.

3.04 The wire may be strung on extension arms when necessary. At any points of up or down pull the extension arms must be securely fastened to the crossarms and the wires safeguarded from coming off the arms. This applies also to up-pulls on crossarms. (See Addendum G31.110).

3.05 There should be no kinks or sharp bends in the wire being strung since these might gradually straighten under tension and make it difficult to obtain equal sags. When the wire is first strung it should be pulled up to a sag of three inches measured in a 130-foot span and left for 12 hours or more before the permanent sagging and transposition work starts. The three inch sag should be obtained by resting the wires on the tops of the crossarms and

pulling them up and sighting across the bottoms of the arms until the sag raises about an inch above the line of sight across the bottoms of the arms. The sag should then be checked by oscillation, using a stop watch and holding the wire in contact with the tops of the crossarms in the oscillating span during this check. If the wires are tighter than a three-inch sag they should be eased off and rechecked. It is desired that the sag be three inches; however, if it is found to be between three inches and four inches, closer adjustment is not required for this part of the work.

3.06 As few sleeve joints as practicable should occur in the wires except, of course, those required to join one stringing section to the next. Short lengths of wire should be used up near corners and in short stringing sections where the positions of sleeves can be watched to prevent catching on crossarms. All sleeve joints should be rolled as straight as practicable.

3.07 The wires should be strung and laid up parallel to each other on the crossarms in the positions between the pins of the pairs to which the wires will be tied (when not in extension arms) so that each pair will be kept separate. Each wire should also be separate from and parallel to its mate. If, for example, wires 1-2 and 3-4 are being strung the 1-2 pair wires should be laid on the crossarm between pins 2 and 3 and the 3-4 pair between pins 4 and 5 or 4 and the pole in the case of an 8 pin arm. The wires should not be laid across the transposition brackets as between pins 1 and 2 or 3 and 4 or twisted on each other when placing them on the crossarms.

3.08 In pairs where a relatively small number of transpositions occur in the run, no transpositions should be placed in the wires before they are pulled up to standard sag. When the wires are separate and parallel it facilitates evening them up and obtaining an accurate sag balance. However, where a relatively large number of transpositions are to be thrown in any pair in the run, it will usually facilitate the work described in Paragraph 9.08 if before the pair is joined to the completed section back on line approximately one-third of the number of transpositions required for the pair for the run are thrown in as twists in the span before the wires are joined to the completed section. After the pair is pulled up to standard sag and the sags accurately evened (in a span on the hoist side of where the twists occur)

these twists should be pushed ahead as described in Paragraph 9.08. Each transposition thrown will eliminate one of these twists until at a point a third the way through the section there will be no twists in the pair. From this point to the end, the twists will be introduced as the transpositions are thrown, as when the wires are parallel at the start of the run.

#### 4. EQUIPMENT FOR PULLING UP WIRES

4.01 The work in adjacent sections of line should preferably progress in the same direction. In this description it is assumed to progress ahead on line. The forward end of each new section of wire of each pair being strung should be equipped on the ground with the standard hoist with the long length of chain, equalizer, and scales as shown in Fig. 1. The eyes at the ends of the 1/8 inch steel rope should be rolled in, in the same manner as in making an eye at the end of a winch rope and each eye should be 1 with an 1/8 inch galvanized wire rope thimble. ends of wires protruding should be covered with two layers of friction tape. A thermometer should be hung and kept on the shady side of the pole. The man assigned to tend the hoist should be supplied with a No. 528 standard receiver with head band, waterproof cord, and clips. A second receiver of the same type should be connected in series with the first, with a convenient length of cord so that he can use it as a transmitter. These receivers should be clipped to one wire of one new pair being transposed and to another wire of another new pair. No battery is required with these receivers. If only one pair is being transposed special arrangements for communication will be required.

4.02 The man on the ground to tend the hoist is in this practice called the "tensioner" and he pulls up the wires or lets in slack as directed by the lineman on the pole who is called in this practice the "transposer."

#### 5. JOINING NEW SECTIONS

5.01 Each new section of wire when transposed and tied in should be temporarily dead ended at a crossarm next to the one at which the wire is led down to the ground where the pulling equipment is attached. These temporary dead ends should be made by clamping the wire to the insulators with the wire snubbing clamps. Where necessary the crossarm used for the temporary dead end should be guyed.

5.02 With the completed section temporarily dead ended the next new section should be sleeved to the free ends of the completed section and the wire laid up on the arms as described in Paragraph 3.08. The next new section is then ready to be pulled up to standard sag.

5.03 When the new wires start at a terminal pole, they should be carried up the pole and dead ended in the standard manner. They are then ready to be pulled up to standard sag with the pulling equipment at the other end of the new section.

## 6. SAGGING THE WIRE

6.01 At the start of the transposition work in each pair on each new section, the wire must be accurately sagged. Only one span need be measured, but this span should be at the opposite end of the section from the adjusting hoist and scale. If work is progressing ahead on line the hoist will be at the forward end and sag should be measured at the rear end of the section. It is important that the two wires of each pair be given specification sag and that the sags of the two wires are the same for if they are the same at the start they should remain the same as the transpositions are thrown throughout the section.

6.02 The sags should be measured by any convenient means known to be accurate. Accurate methods of sagging wires are given in Appendix G31.115.1 Part 3. The pair oscillation method, Figs. 3 and 4 may be used to test the evenness of the sags when the wires are tied in.

6.03 The lineman who will throw the transpositions (the "transposer") should carry a No. 528 receiver with short cord and clips to connect to the same wires that the tensioner's receivers are connected to. After the first transposition is thrown in each pair the line wires will be twisted together in the span and either wire of the pair may be used as one side of the talking circuit to reach the tensioner. No battery is required for use with these receivers which can be used both for talking into and listening. Only one transposer should have his receiver clipped to the talking circuit at the same time.

6.04 When ready to sag the wires the transposer tells the tensioner at the far end of the new section to be transposed to pull up the pair with his hoist

until the scales read the tension corresponding to the loading area, size of wire, and temperature (read on the thermometer) shown in Table A. The transposer then tests the wire for standard sag and calls to the tensioner for more or less tension and for evening up the wires when this is required to give specification sag. When the sags are correct and even for the pair the transposer gives the tensioner an "O.K." and the tensioner then reads the scales. This reading should be duplicated (approximately) after each transposition has been completed for the entire section worked, except for changes due to temperature variations.

#### 7. CORRECTION FOR TEMPERATURE CHANGES

7.01 The tension in line wire and the corresponding sag, changes with temperature. The tension in the wires should, therefore, be adjusted by the tensioner to compensate for any substantial change in temperature that may occur during the transposition work. For example, if the scales read 158 at the start when the sags are correct and 128 wire is being strung with light loading sags, Table A shows a change of 7 pounds in tension for a change of 5° in temperature. If the temperature rises, 10°F during the work, the reading on the scales at times when transpositions are not being thrown should be reduced 14 pounds. To reduce the tension it will usually be necessary to let in one link of slack on the hoist. Closer adjustments than can be made by letting in or taking out one link of the hoist chain are not warranted. Readings between the five pound marks on the scale should be approximated.

7.02 As the transposer works toward the tensioner it is usually found that the tension in the wires increases irrespective of the temperature. The scales should be watched by the tensioner and between periods of throwing transpositions adjustments should be made by letting in one link (or taking it out when necessary) to keep the tension approximately the same as at the start of the run (adjusted for any temperature change that has occurred).

#### B. TYING IN

8.01 The wires should be tied to the insulators at the straight line points (not at transpositions except as specified in G31.134), using the ties specified in the detail plans. At the start of a run of new wire, after the wires have been given specification sag they should be tied to the insulators at the straight line positions (in the direction in which the

work is progressing) up to the first transposition. When this transposition has been made as described in Part 9, the wires should be tied in on the next straight line points up to the second transposition and so on. Care should be taken by men tying in not to unbalance the sags by leaning against the wires after they are tied or by otherwise unbalancing the wire tensions. Any twists between the wires in the span back on line should, of course, be pushed ahead on line before tying in.

## 9. THROWING POINT TRANSPOSITIONS

9.01 The transposer places the wire snubbing clamps on the insulators on the side of the crossarm toward the completed section as shown in Fig. 2. Care should be taken to see that the wire is properly in place in the wire groove of the clamp and that the inside of the hook fits close up to and is in contact with the insulator wire groove. This is important for any play left between the clamp hook and the insulator when the clamp is tightened will introduce excess sag in the span back on line when slack is given ahead on line and would cause an inequality in sags in the pair from that point forward.

9.02 When the second wire snubbing clamp has been placed the conditions at the first clamp should be checked for if the arm is leaned against while tightening the second clamp the first clamp may come too far back or forward with regard to its insulator. The inside of the hooks of both clamps should just bear evenly against the wire grooves of their respective insulators when both clamps are tight on their respective wires.

9.03 The clamps should be made tight enough so that the wire will not slip in them but not so tight as to mark or damage the wire.

9.04 The transposer then attaches the B wire slack puller to the crossarms so that the T bar is midway between the wires and rests on top of the transposition bracket (or crossarm when break irons are used) and the top of the T hooks beneath the arms of the bracket or ends of the transposition break irons on the side of the crossarm toward the wire snubbing clamps. The wire grips should then be attached to the line wires as shown in Fig. 2 so that the clamps are approximately the same distance from the slack puller. The small wheel which fastens the wire rope to the puller shall be kept lubricated to assist in evening

the tension between the wires. The eyes at the ends of the wire rope should be rolled in, in the same manner as in making an eye in the end of a winch rope and each eye should be lined with an 1/8 inch galvanized wire rope thimble. Any ends of wires protruding should be covered with two layers of friction tape.

9.05 The transposer should then call to the tensioner for slack for the transposition. (The amount of slack is specified in Paragraph 9.06.) The transposer when the slack has been released, pulls just enough slack to the transposition to lay the wires properly transposed over the tops of the insulators into the wire grooves. The transposer then releases and removes the wire puller, tells the tensioner that the transposition has been made and when the tensioner says that the specification tension has been restored the wire snubbing clamps are removed and the transposition is completed.

9.06 The amount of slack used for each transposition is as follows:

	<u>Inches</u>	<u>Links Reqd. for Transposition</u>
6" spaced pairs on point transposition bracket	2	2
8" spaced pairs on point transposition bracket or break irons	3-1/4	3
12" spaced pairs on point transposition bracket	7-1/4	7
12" spaced pairs on break irons	6-1/4	6

More than this slack is required to slip the wires over the tops of the insulators. Each link on the chain of the standard hoist used by the tensioner measures one inch. One or two links of extra slack are usually needed to make the transpositions farthest from the tensioner and two or three extra links for transpositions close to the tensioner. These extra links given to make the transposition are taken back after the transposition is thrown and before the wire snubbing clamps are removed from the transposition insulators.

9.07 For example, with 8-inch spaced pairs at the start of the run 4 or 5 links of slack should be let in the wires by the tensioner when the transposer calls for slack for a transposition. When the transposer says the transposition has been made, one or two

links should be taken up on the hoist by the tensioner leaving three links (3") for the transposition. The 1/4" is usually obtained by stretch of the wire but if this excess increases the tension gradually, as shown on the scales, a link should be let in between the periods when the transpositions are made as described in Paragraph 7.02. When the transposer is within two or three transpositions of the end of the run, the tensioner should let in 5 or 6 links and after the transposition has been made take back 2 or 3 links to leave in the three links for the transposition. When the tensioner has given slack for a transposition and after the transposer has thrown the transposition, the tensioner may find that after he has taken back the extra link or links the scales will not come back to the same reading. This is thought to be due principally to friction of the wire on the tops of the crossarms over which the wire bends due to its own weight. Before making an adjustment with the hoist the tensioner should place part of his weight with his hands on the pair in the span between the scale and grips and the first crossarm to overcome this friction and even out the tension in the run and then read the scale. This should be done so as not to unbalance the wires. With practice it will usually be found that this manipulation is all that is required to return the scale to its former reading.

9.08 When the first transposition is thrown, a twist is introduced in the pair of wires in the span ahead on line. (Except when twists are initially placed in the pair.) Before tying in the wires at the next pole ahead on line this twist should be pushed ahead and kept ahead of the tying and transposition work. At the next transposition a second twist is introduced. All twists so made should be pushed ahead as the work progresses and eliminated at the end of the run when the ends of the wires are freed to connect to the next run of new wire.

## 10. CONTROL OF SAGS

10.01 Whenever anything occurs during the work which it is thought has unbalanced the sags or has materially changed the wire tensions unintentionally, check measurements can be made of the sags and equality of sag between the wires of the pair in the same manner as at the time the wires were originally given specification sag. The pair oscillator is a ready means of checking equality of sags in completed work. It cannot be used at corners where the arm bisects the corner since the spans of both wires of the pair are

not the same length or in spans made irregular by the presence of sleeve joints. The pair oscillator should be placed on the wires far enough out from the cross-arm so that pulling the wire to it will not unbalance the sags.

10.02 At such intervals as are deemed necessary, the sags and equality of sags in completed spans should be checked, using a stop watch to make sure that the average sag difference between wires of any pair strung will not exceed .70 inch and the sag of each wire in any span does not deviate from the specified sag (given in the table of sags) by more than one-inch over or one inch under. When these limits are exceeded the sags should be adjusted to meet them.

TABLE A  
WIRE STRINGING TENSIONS  
POUNDS

Temperature F° in Shade	Light Loading			Medium and Heavy Loading		
	104	128	165	104	128	165
-10	170	290	460	152	255	405
-5	165	280	445	146	245	390
0	160	270	430	140	235	375
+5	153	260	415	134	225	358
+10	147	251	400	128	215	342
15	141	242	385	122	205	327
20	136	232	370	117	195	312
25	131	222	355	112	186	297
30	126	212	340	107	177	282
35	121	203	325	101	168	267
40	116	194	310	95	159	253
45	111	185	295	90	150	240
50	106	176	280	86	142	227
55	100	167	266	81	134	213
60	95	159	252	77	127	200
65	91	151	239	72	119	189
70	87	144	226	67	112	178
75	82	136	214	63	106	168
80	78	129	203	60	100	158
85	74	122	194	56	95	149
90	70	116	185	53	90	140
95	67	111	177	50	86	133
100	64	106	169	48	82	126
105	61	101	160	46	78	120
110	58	96	152	45	74	114
115	55	92	143	43	70	108
120	52	88	135	42	68	104
125	49	84	129	40	66	101
130	47	80	123	38	64	98
135	45	77	117	36	62	95

Change in Tension  
For 5° Change in  
Temperature  
Between

-10 to +5	5	10	15	6	10	15
+5 to +20	5	9	15	6	10	15
+20 to +40	5	9	15	6	9	15
+40 to +60	5	9	13	5	7	13
+60 to +90	4	7	9	3	5	10
+90 to +110	3	5	8	2	4	7
+110 to +125	3	4	7	2	2	3
+125	2	4	6	2	2	3

OPEN WIRE  
STRINGING COPPER WIRE  
POINT TRANSPOSED

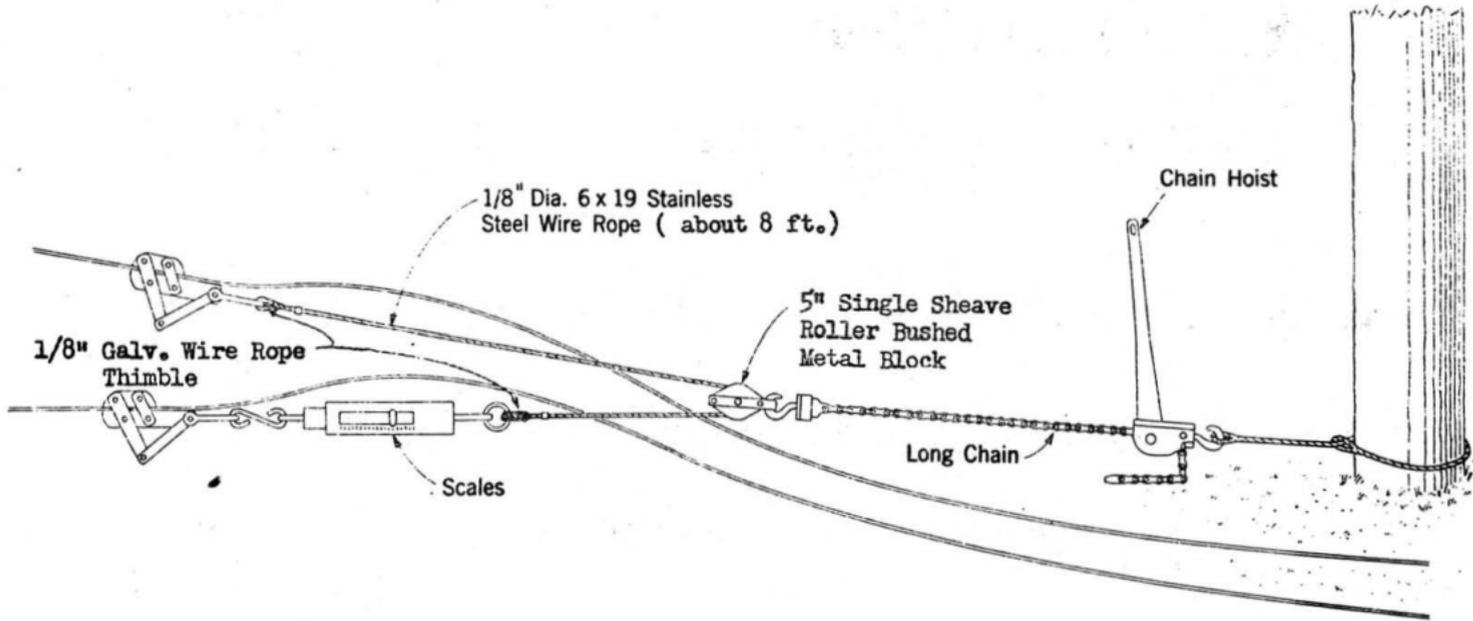


FIG. 1

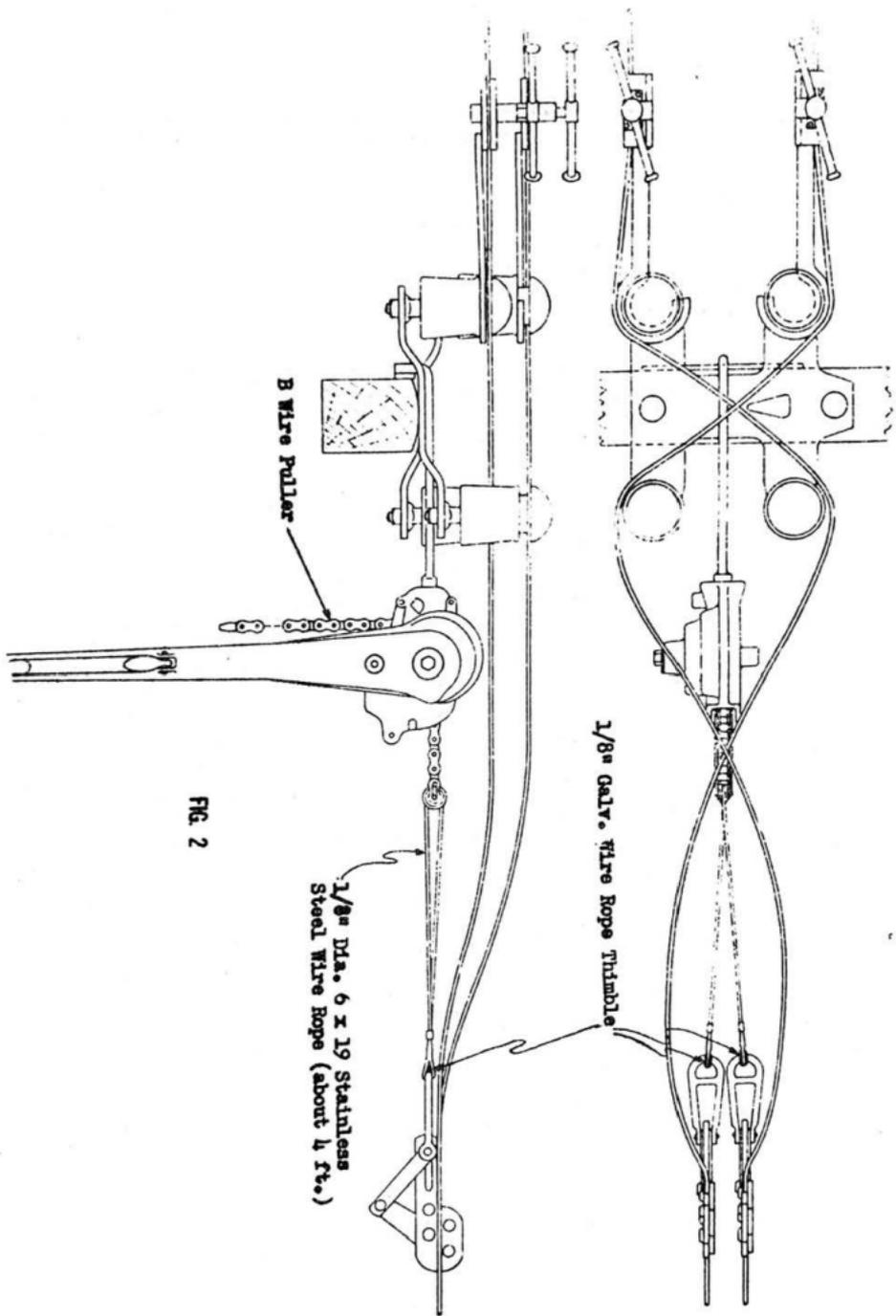


FIG. 2

B Wire Puller

1/8" Dia. 6 x 19 Stainless Steel Wire Rope (about 4 ft.)

1/8" Galv. Wire Rope Tumble

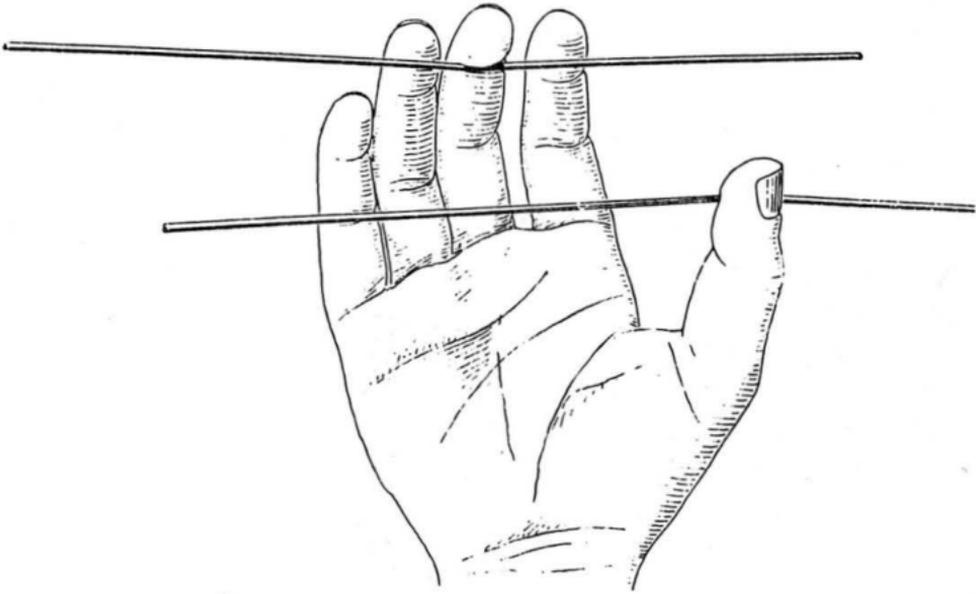
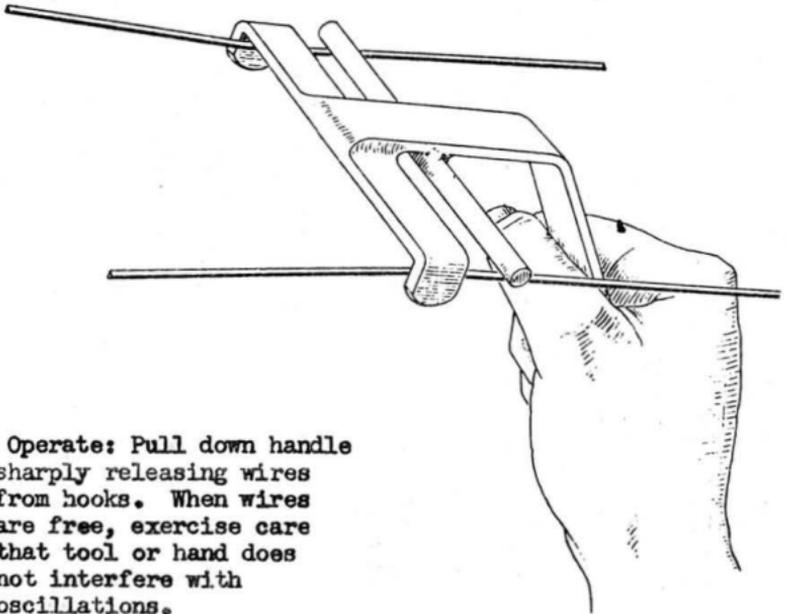


FIG. 3



To Operate: Pull down handle sharply releasing wires from hooks. When wires are free, exercise care that tool or hand does not interfere with oscillations.

FIG. 4