GANG: TECHNICAL AND CONCEPTUAL APPLICATIONS TO LOOM CONTROLLED WEAVE STRUCTURES

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In the late 1950's, as an undergraduate student in Textile Design at The Rhode Island School of Design (RISD), Providence, Rhode Island, I encountered the somewhat obscure term "gang". This term was used by the delightful man who had spent the major portion of his life working in the weaving mills of New England and his latter years as the power loom supervisor for RISD. As a textile designer and educator, I have found this little known term to be one of the most important concepts for understanding loom-controlled weave structures. At this point I have not discovered whether this was a colloquial and informal term used by a few mill workers or a once common term which has not been in common usage in the 20th Century American textile industry.

According to Webster’s New World Dictionary of the American Language, Second College Edition, a gang is "... a set of like tools, machines, components, etc., designed or arranged to work together... to arrange in a gang, or coordinated set".

A gang is a concept which can be applied to a specific weave structure or a group of weave structures, e.g., honeycomb weave, block weaves, multi-layer weaves, tied weaves, backed weaves, compound weaves, etc. Although the majority of weave structures which relate to this concept can be totally loom-controlled, this concept can be applied to structures which involve hand manipulation, e.g., inlay. The gang concept encompasses a modular use of harnesses/shafts to control specific ends, sections, and/or layers within the interlaced structure. It is also an approach to the use of the multi-harness/shaft loom, whether the control groups are actual or conceptual.

In general, weave structures are examined relative to their specific orders of interlacement or relative to a class of specific weaves. However, the gang concept becomes the universal factor which is used to identify common characteristics among many weave structures and loom functions. In addition, this concept can become a logical basis for deciding how to use the multi-harness loom as a tool.

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Sometimes the obvious concept is almost lost in the vast quantity of current complex technology. We tend to compartmentalize our thinking and thus often miss the universal concept. This paper will present the gang concept as the key to understanding diverse weave structures and the multi-harness/shaft loom which is used to construct these structures.

MODULAR USE OF HARNESS/SHAFTS

1. A gang can consist of one or more harnesses/shafts. The draw in Figure 1 has eight 2-harness/shaft gangs (A to H) and one 4-harness/shaft gang (J). Other 4-harness/shaft gangs are formed to construct specific interlacements within the weave.

2. It takes two or more gangs to construct a loom-controlled weave structure. Figure 1 has nine gangs and 20 harnesses/shafts. However, even the simplest interlacement requires two sheds.

3. The harnesses/shafts in a gang may or may not be adjacent to each other. In Figure 1, there are adjacent harnesses/shafts within each individual gang and within the gangs which are used to construct the areas of plain weave, e.g., gangs A and B form a new gang of adjacent harnesses/shafts when used to construct plain weave. In Figure 3, the harnesses/shafts in the gang which forms the outline of the honeycomb cell are not adjacent to each other. The gangs in Figure 7 also illustrate this point.

4. The gangs which form a weave structure may or may not have the same number of harnesses/shafts. Thus, when a weave structure has the same number of harnesses/shafts in each gang, has an even number of harnesses/shafts in each gang, or has an odd number of harnesses/shafts in each gang, it is a coincidence and not a rule. Figure 1 has two and four harness/shaft gangs.

5. Larger gangs can be made up of several smaller gangs, and, all of these can operate within the construction of the same weave structure. Figures 1, 3, 4 and 7 illustrate this point.

6. Gangs can be used as separate entities allowing weaves to change at the same time or at different times within the same structural design. In the first 48 picks in Figure 1, the plain weave controlled by gangs A, B, E and F, continues for 48 picks while one basket weave controlled by gangs C and D changes every 12 picks and the other basket weave controlled by gangs G and H changes every 8 picks. In the last 48 picks in Figure 1, the plain weave controlled by gangs C, D, G and H, continues for 48 picks while one basket weave controlled by gangs A and B
changes every 24 picks and the other basket weave controlled by gangs E and F changes every 16 picks. The selvage controlled by gang J is a twill for 96 picks.

7. The gangs needed to construct a weave may or may not remain constant. In Figure 1, gang J is the only one which remains constant.

8. Essentially, a single harness/shaft is a gang since specific ends are group controlled by having been placed in heddles on a specific harness/ shaft.

A SELECTION OF TECHNICAL AND CONCEPTUAL APPLICATIONS

1. Gangs allow two or more loom-controlled weave structures to be constructed, adjacent to each other in the direction of the warp, which could not be achieved by simply changing the draw within the same gang. In Figure 1, the plain weave, the basket weaves, and twill weave illustrate this point. In Figure 2, the weft faced satin, warp faced satin and the twill form stripes in the direction of the warp. In Figure 3, the mock satin damask has warp faced and weft faced mock satin weaves interlacing at the same time in the direction of the warp. All of these require the use of gangs in order to allow the loom to operate without hand manipulation of the warp.

2. Gangs allow two or more loom-controlled weave structures which require a different number of harnesses/shafts to be constructed adjacent to each other in the direction of the weft/filling when: (a) the draw is compatible with the desired weaves, and, (b) the total number of harnesses/shafts required for each weave can be evenly divided into the total number of harnesses/shafts in the existing draw. (Figure 4)

3. Gangs are used when constructing a wide variety of weave structures which may require one or more warps. When examining a weave structure, it is important to not confuse the need for a gang with the need for an additional warp. In Figure 5, the tie-down ends need to be controlled by a separate gang of two harnesses/shafts but do not require an extra warp. In Figure 6, a second warp and a gang of 4-harnesses/shafts is required because the ground warp interlaces more frequently than the supplementary warp for the figure motif.
4. Although a specific group of warp ends must be isolated on a specific harness/shaft, the final choice of a specific harness/shaft is generally arbitrary and/or for logical convenience. The ends on harness/shaft #1 could be on #5, or on any other harness, as long as the same ends are isolated as a specific group/gang and are placed in the same location in the warp. In Figure 5, the tie-down ends (gang A) must be isolated on two harnesses/shafts. However, they do not have to be on the first two harnesses/shafts.

There are some exceptions, e.g., the unique functional aspects of the dräll pulley system would require two specific groups of warp ends to be isolated on a set of two harnesses/shafts which work together forming a gang.

5. All multi-layered weaves employ the gang concept. In Figure 7, a variety of 4 and 8 harness/shaft double weaves are shown. In each case the gangs needed to control each layer can be changed according to the weave for each layer and/or the color order. All of these changes can occur within the same structural design.

6. Many hand manipulated weave structures utilize conceptual and actual gangs. For example, in Figure 8, two types of in-lay are shown. In one, the in-lay shed is formed by raising one of the harnesses/shafts which is raised for the adjacent ground shed. Thus, any weave structure can be used as long as this rule is followed. The gang which controls each in-lay will change with each accompanying ground shed. In the other, a supplementary warp is required for the in-lay. The supplementary warp is controlled by a 2-harness/shaft gang (1 and 2). The in-lay shed is formed by raising one of the harnesses/shafts which controls the supplementary warp. This same harness/shaft also must be raised for the adjacent ground shed.

CONCLUSION

Actual and conceptual application of the gang concept can make clear the technical functioning of a wide variety of looms and weave structures.
REFERENCES


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Figure 1. (original design by author in 1961)
DRAW

TIE-UP

ONE REPEAT

A = 5 harness/shaft weft faced satin
B = 5 harness/shaft warp faced satin
C = \( \frac{2}{3} \) will

Figure 2.
**MOCK SATIN DAMASK**

Repeat a treadling several times.

**CELL:** plain weave (gang 1-4)

**CELL:** plain weave (gang 5-8)

**CELL:** \( \frac{2}{2} \) twill (gang 1-4)

**CELL:** \( \frac{2}{2} \) twill (gang 5-8)

**OUTLINE:** gangs: (1-3-5-7) & (2-4-6-8)

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Alternate cells (repeat a treadling several times) with 2 picks of outline between each cell.

**HONEYCOMB**

Figure 3.
- straight draw - 20 harnesses/shafts

- 20 harness/shaft satin - one repeat

- 10 harness/shaft satin
  one repeat weft - two repeats warp

- 5 harness/shaft satin
  one repeat weft - four repeats warp

- 4 harness/shaft mock satin
  one repeat weft - five repeats warp

- 2 3 1 2 1 3 1 2 2 1 1 1 right hand twill
  one repeat

- 3 4 right hand twill
  one repeat weft - two repeats warp

- 2 3 right hand twill
  one repeat weft - four repeats warp

- 2 2 right hand twill
  one repeat weft - five repeats warp

Figure 4.
Gang A (harness/shaft 1-2) controls the tie-down ends that form the ribs. These tie-down ends must be separately controlled but do not require an extra warp.

Repeat each treadling unit several times. Use a weft that is thicker than the warp for the odd numbered picks. Use a weft that is the same size as the warp for the even numbered picks.

Figure 5.
Gang A (harnesses/shafts 1-4) controls the ground weave. Gang B (harnesses/shafts 5-8) controls the supplementary warp for the figure motif.

Figure 6.
4-Harness/Shaft Double Weave

GANG (HARNESS/SHAFT): 1-3 top layer
2-4 bottom layer

2-4 top
1-3 bottom

1-2 top
3-4 bottom

3-4 top
1-2 bottom

1-4 top
2-3 bottom

2-3 top
1-4 bottom

TREADLINGS

4-Layer Double Weave

GANGS
1-5 top layer
2-6 second
3-7 third
4-8 bottom

1-3-5-7 top layer: $\frac{2}{7}$ twill
2-4-6-8 bottom layer: $\frac{2}{7}$ basket

Double Weave

1-2-3-4 weft faced mock satin
5-6-7-8 warp faced mock satin

Damask

TREADLING

Figure 7.
IN-LAY: Any single layer weave structure can be used as long as the harness/shaft raised for the in-lay shed is one of the harnesses/shafts raised for the adjacent (immediately following) ground shed.

(a) Weave Structure
(b) Picks 2 and 4; Plain Weave Ground
(c) Picks 1 and 3; In-Lay

(a) Weave Structure
(b) Picks 2, 4, 6, and 8; Plain Weave Ground
(c) Picks 1, 3, 5, and 7; In-Lay

(a) Weave Structure
(b) Picks 2, 4, 6, and 8; 2 Twill Ground
(c) Picks 1, 3, 5, and 7; In-Lay

This example has separate warp ends on harnesses/shafts 1 and 2 for the in-lay tie-down ends.

(a) Weave Structure
(b) Picks 2 and 4; Plain Weave Ground
(c) In-Lay ends

(a) Weave Structure
(b) Picks 2, 3, 5, and 6; 2 Twill Ground
(c) In-Lay ends

(a) Weave Structure
(b) Picks 2, 4, 6, and 8; 2 Twill Ground
(c) In-Lay ends

Figure 8.