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Brief Introduction to The application of Laser Blanking Line on Automobile Sheets

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Abstract. In this paper, the laser blanking line, which is one of the future development directions of uncoiling blanking line is introduced. The laser blanking line and the traditional blanking line are compared from the perspective of technological process. It shows that the laser blanking line has the following advantages ,it is stamping blanking line, laser cutting machine, cutting to length line three different functions of processing line integration, and it can process the complex shape sheets, without die and without die cost, short process line, lower floor area.

1. Introduction

In recent years, China's automobile production capacity has increased rapidly, and this amazing and sustained growth has led to the booming development of China's automobile industry. In order to guarantee the healthy development of automobile industry, the state formulates the corresponding laws and regulations, lightweight level has become the development of the auto permanent theme, high strength steel, aluminum alloy and composite materials have significant advantages in automobile weight, consumption and security.

In the face of the continuous use of new materials, accelerated product update cycle and reduced batch, the traditional blanking line has been unable to meet the production needs of automobile enterprises [1-4].

The latest laser blanking line made by one Germany Company, the moving metal coil can be cut and dropped by laser, the various shaped pieces are used to shape the body in subsequent processes. Compared with conventional blanking line, this blanking line uses fiber laser in cutting process, so there is no need to use die [5-7].

2. Automotive lightweight materials and processing

2.1. High Strength Steel and Aluminum Alloy

2.1.1. High Strength Steel. In recent years, the research on the application technology of advanced high-strength steel for automobile has been very active, the strength of ultra-high strength steel has reached or exceeded 1500MPa. At present, advanced high-strength steel plate has developed to the second generation and developing towards the third generation of high-strength steel with high formability and ultra-high strength .



There was no uniform definition of high strength steel before. In ULSAB project, the yield strength of 210-550 mpa steel is defined as a high strength steel (HSS), the yield strength of 550 mpa steel is defined as ultra-high strength steel (UHSS), while the yield strength to cover the high strength steel HSS and UHSS is defined as advanced high strength steels (AHSS). Table 1 shows the types, names and characteristics of all kinds of steel used in automobiles.

Table 1. Types, code names and features of steel for automobiles.

Steel Type	Code Name	Feature
Soft Steel	LC	Unalloyed low carbon aluminum-stabilized steel
	IF	Interstitial-Free Steel
HSS	BH	Baked hardened steel
	IF-HS	high strength IF steel
	P	Phosphorous alloyed high strength steel
	IS	isotropic steel
	CMn	solid - soluble reinforced high - strength steel
	HSLA	High Strength Low Alloys
AHSS	DP	Dual-Phase steel
	TRIP	Transformation Induced Plasticity
	PM	Partial or complete martensite steel
	CP	Complex phase steel with reinforced ferrite, bainite and martensite mixtures
HMS	HMS-TRIP	Strain induced phase transition
	HMS-TWIP	Twin crystals are produced in the strain process

2.2. Mechanical processing of two types of materials

The tensile strength and elongation range of high strength steel materials are high. High strength steel needs high pressure and shear force, it also has high requirements for material and heat treatment of die or tool. It is easy to get stuck material, obvious crack or small crack in stamping and shearing process

Laser cutting is the rapid heating of materials to vaporization temperature in order to form a hole by high power density light generated by laser beam focusing, and the beam moves relative to the material to obtain narrow continuous slits [8].

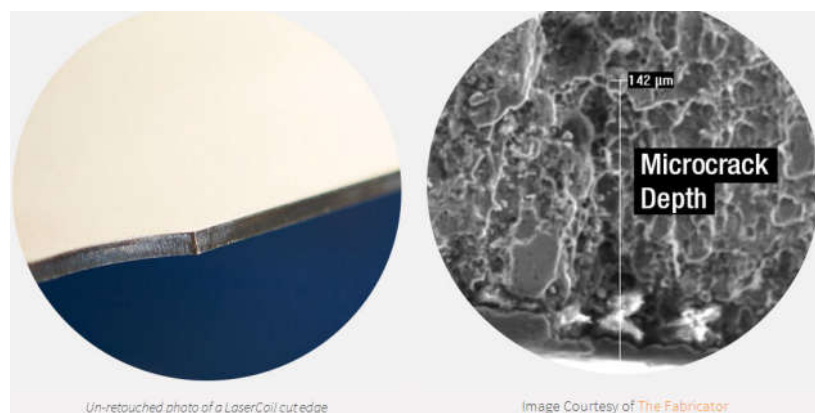


Figure 1. Cracking and tiny cracks.

Due to the soft material of aluminum alloy, it is easy to produce such defects as scratch, deformation and burr when pressing and dropping materials. It is difficult to control the clearance value and cleanliness of stamping die

2.3. The change brought by fiber laser cutting technology

Since CIMIT2009 Beijing exhibition, German MESSER exhibited fiber laser cutting machine in China for the first time, the share of fiber laser cutting in China has increased linearly in recent years. Compared with the traditional carbon dioxide laser cutting, the cost of optical fiber laser cutting machine is reduced by 30%, and the cutting speed of thin plate increases by 2-8 times. It is a good choice for the automobiles because more thin sheets for cars. Figure 2 shows the fiber laser cutting parameter curves of different power and plate thickness.

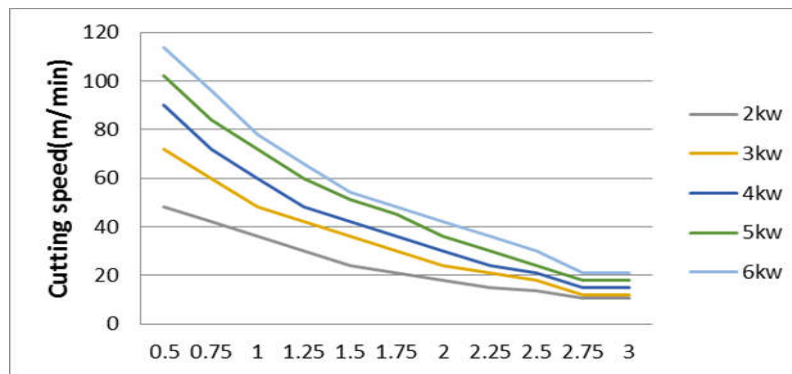


Figure 2. Fiber laser cutting parameter curve.

At present stage, the application of laser cutting machine in automobile industry mainly three-dimensional cutting, including six axis robot laser cutting, 3 dimensions with 5 axis laser cutting machine, which is applied to replace punch blanking die and trimming punch die, thus a pair of punch blanking die can be saved on the mould, Saving 2 side trimming punch die on the drawing die. Under special circumstances, if there are Angle cutting die and blanking die, can also be saved [9].

3. Laser blanking line

3.1. Laser blanking line overview

At present, different types of sheet used different functions of the blanking line, including stamping blanking, flying shear cutting blanking, and shear cutting blanking and so on. The core machines of these blanking lines are press, fly pendulum shears and pendulum shear.

The laser blanking line replaces the core machine with a laser cutting machine. By laser cutting this kind of non-contact processing instead of stamping, shear processing, to complete the cutting and blanking of shaped plate. Figure 3 shows evolution diagram of laser blanking line, it is stamping blanking line, laser cutting machine, cutting to length line three different functions of processing line integration [10].

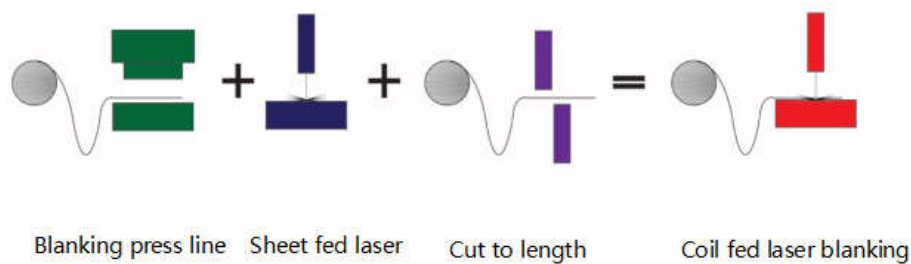


Figure 3. Evolution diagram of laser blanking line.

3.2. The process route of laser blanking line

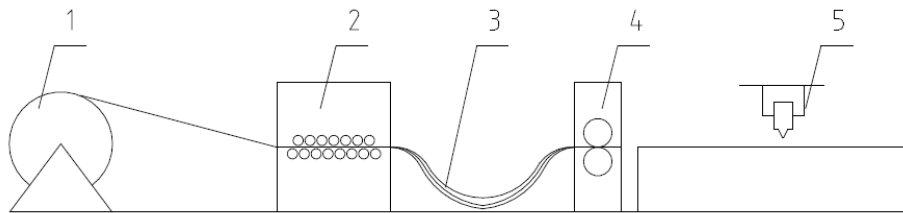


Figure 4. The process route of laser blanking line.

The process route of laser blanking line is shown in Figure 4. The content is as follows:

- (1) The strip coil 1 is loaded on the uncoiler spool, and the strip head is pinched into the leveler 2;
- (2) Then the strip enters the loop 3 after leveler. The main function of the loop is to compensate the speed difference of the leveler 3 and pinching rolls 4.
- (3) There are pinching rolls to pinch the strip into the laser cutting unit 5.
- (4) There are three laser cutting status including: static cutting, dynamic cutting and reciprocating cutting. The static cutting is the same as the existing laser cutting machine, which realizes the cutting by X and Y axis interpolation. While the strip is always moving forward in dynamic cutting status, in this way, the speed of X axis should add the moving strip speed. The strip will move forward and backward which is pinched by the pinching rolls 4, and cutting the strip by cooperating with the Y axis moving.
- (5) Convert the dwg or dxf file (which includes the needed shape) into the cutting program by special software.
- (6) If needed, equip with the automatic gripping device and stacking machine after cutting.

3.3. The advantage of the laser blanking line

3.3.1. The properties of the laser blanking line. (1) It is not difficult to process the complex shape for laser blanking line with the laser cutting technology development, while not easy for traditional blanking line.

(2) It is unnecessary to change moulds according to different shapes using laser cutting, which saves the cost of the purchase coat and storage cost.

(3) It is more efficient to compare the strip coil way with single plate way to load or unload, and ensure the uniform processing quality.

(4) Less installing cost and less occupied area.

(5) It is no needed to have moulds, so no moulds cost, and decrease the minimum quantity of the blanking line largely. No matter how few orders can be processed through the laser blanking line. It is benefit to enterprise or manufacturer.

(6) Don't consider the material strength with the laser cutting, so increase the range of the material processing. It is easy to cut the high-strength steel or aluminum alloy strip in this way and no problems of rip and being cracked.

(7) Make the layout automation through special program, more efficient than traditional blanking line.

(8) Shorten the trial production and delivery cycle of small batch and new products

(9) The cutting efficiency is related to the laser device power and the length of the process path, so the total efficiency is about 40% of the traditional blanking line at most.

3.3.2. Cost comparison between laser blanking line and traditional blanking line. The comparative condition of the sample is shown as figure 5, material is galvanized, thickness is 0.76mm, Length is 2133.6mm, width is 1524mm.



Figure 5. The condition of the sample 1st.

The comparison result is shown as the table 2

Table 2. Cost comparison between laser blanking line and traditional blanking line

No.	Parameter	Traditional blanking line	Laser blanking line
1	Mould cost (\$)	250,000	0
2	Run-up time (min)	15	≤2
3	Product quality (piece)	1,250	1,250
4	Efficiency(piece/per min)	20	6
5	Total processing time (min)	80	215
6	Single product cost (\$)	21.35	20.15
7	Main machine power (kw)	75	4
8	Water-colling machine power (kW)	0	5
9	The cost per hour (\$)	9	2.9

Note:

- (1) The comparative data are from foreign exchange material for reference only
- (2) The life of the die is generally counted as 100,000 pieces of stamping parts
- (3) At the same time, the production capacity of laser blanking line is only about 30% of traditional blanking line
- (4) But the cost per unit time is only about 30% of the traditional blanking line.
- (5) The production cost of single piece is about 94% of the traditional blanking line.

3.3.3. Cost comparison between laser blanking line and laser cutting machine.

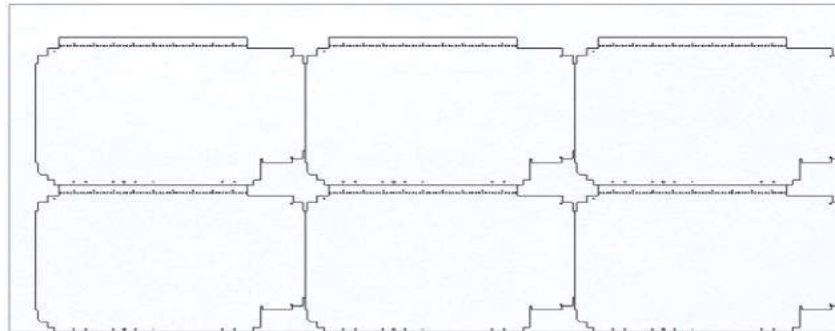


Figure 6. The condition of the sample 2st.

The comparative condition of the sample is shown as Figure 6, material is carbon steel, thickness is 1.2mm, Length is 990.6mm, width is 685.8mm

The comparison result is shown as the table 3

Table 3. Cost comparison between laser blanking line and laser cutting machine

No.	Parameter	Laser cutting machine	Laser blanking line
1	Product quality (piece)	1,300	1,300
2	Total processing time (h)	31.25	8.67
3	Total cost of material (\$)	9,102	7.283
4	Labor cost (\$)	1,536	0
5	Coefficient of utilization	81%	94%
6	Single piece cost (\$)	8.02	5.68

Note:

- (1) The comparative data are from foreign exchange material for reference only
- (2) There are the storage cost and delivery cost in single-sheet way.
- (3) The laser blanking line can improve the coefficient of utilization
- (4) The processing total time includes the loading strip time, cutting time and stacking time.

3.3.4. Comparison between laser blanking line and laser cutting machine with automatic loading-unloading (LCA). The comparative condition is the same as the Figure 5.

The comparison result is shown as the table 4

Table 4. Comparison between laser blanking line and LCA.

No	Parameter	laser cutting machine with automatic loading-unloading	Laser blanking line
1	Product quality (piece)	1,300	1,300
2	Total processing time (h)	13.38	8.67
3	Total cost of material (\$)	9,102	7.283
4	Stacking cost (\$)	1,085	0
5	Coefficient of utilization	81%	94%
6	Single piece cost (\$)	7.82	5.68

Note:

- (1) The comparative data are from foreign exchange material for reference only

(2) There is the storage cost and delivery cost in the laser cutting machine with automatic loading-unloading way.

4. Conclusion

Laser blanking line is a revolutionary system combination, which integrates three lines of punching blanking line, laser cutting machine and cross-cutting line. It meets the requirement of the auto lightweight high strength steel, aluminum alloy processing, also meets the small batch and many varieties of the market demand. It has the very strong competitiveness and broad development prospects and market value is infinite.

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