Design and Development of a Gasoline-Fed Welding Machine – An Alternate for Oxy-Acetylene Welding

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Abstract

The gasoline-fed welding machine – an alternative for oxy-acetylene welding was designed and fabricated using metal working concepts. The fume reservoir fuel tank and accessories, including welding torch assembly were fabricated. The proposed gadget – a gasoline fed welding machine as an alternative to oxyacetylene-fed welding was conceptualized to considerably decrease the fuel consumption in welding without sacrificing the quality of the finished product with what is already acceptable to the market – the oxyacetylene-fed welding machine.

Qualitative testing were made to identify the capacity of the set-up as to the type of material connected as well as the purposed of the welding connection, adjustments needed per type of material and purpose; observations as to the machines performance when wielding the identified materials, application to different filler rods, as well as position and motion to the torch.

Interpreting the observed results per applied pressure and temperature, with the type of material connected, the following could be derived; light color of flame suggest a pressure of 0.5 psi (3.454KPa) and temperature close to 3149oC. Bright/faint red flame indicated that a pressure from 2 psi to 3 psi (13.816 to 20.724 KPa) and a temperature close to 3260oC is already attained. Aluminum melts a 343oC And would attain a sound weld when connected to another aluminum materials at this temperature.

The gas-fed welding machine is only capable of producing light and full red color of flames, while oxy-acetylene could produce three flame qualities, light, dull red and bright/faint red. The machine could not weld steel material to itself, and to other materials, specifically aluminium and copper.

Technical fields where gasoline-fed welding machine is advisable for refrigeration and air conditioning electrical shop, automotive shop and goldsmith bracing joints of copper tubes and soldering of splitter and joints. It is also for

repair of leaks, broken and joints of clutch, steering wheels and brake piping systems of automobiles. And finally for broken gold jewelry repairs, gold smithing and welding of gold bars.

Introduction

Background of the Study

Industries have been dubbed as the backbone of economy. In a country where the economy is at stake, industries play a significant role in spurring economic activities Industries are further supported by technologies which facilitate the operation of machines and processing of raw materials.

Occupying the basic foundation of technologies are scientists and inventors. It is their prime role to continuously search for facilitative gadgets to improve productivity in terms of minimized use of resources.

Creativity is a human capacity to conceptualize mechanisms from abstraction to actualization. Need has been the driving force to cause people to develop their creative thoughts.

Welding is presently the most handy method of fastening structural members in construction, as well as in working with building accessories, farm gadgets, and other domestic appurtenances by the metal working industry. This is the process of joining materials (usually metals) by heating them to suitable temperatures such that the materials coalesce into one material (Salmon and Johnson, 1996: 190). In structural undertaking, fastening members in the joint of a truss could be done by means of filler materials and connecting plates, the most common of which is the gusset plate. Because of the heat requirement, the fastened members have to be subjected to heat to sufficiently melt the joining members. This is the role of the oxy-acetylene, the fuel most frequently used to operate welding machines globally.

Due to the fast increase of oil prices, the cost of oil products, which are the key to the operation of mechanized gadgets, have continuously rose. Their presence is inevitable, thus, industries totally depend upon oil to operate. This now causes the dilemma of industries, small and big alike. However, the small businessmen and entrepreneurs are more affected by the increase in oil prices. Thus, the need to design low-consuming yet comparably performing industrial gadgets would somehow ease up oil-related investments of industries.

This proposed gadget- a gasoline-fed welding machine as an alternate to oxyacetylene-fed welding, has been conceived to considerably decrease the fuel consumption in welding, without sacrificing the quality of the finished product with what is already acceptable to the market- the oxyacetylene-fed welding machine.

Objectives

Generally, this research work came out with the design of a gasoline-fed welding machine that would comparatively perform as an oxyacetylene-fed welding machine, with identified limitations as to types of material used and the purposes the welding is intended for.

Having attained the main objective, the following specific objectives were realized:

1. Fabricated the fume reservoir and fuel tank and accessories, including welding torch assembly.
2. Tested the performance of the connected major parts for three types of materials: a) aluminum, b) copper, and c) steel when connected to similar materials, as well as the performance when different materials are welded together.
3. Identified the specific purposes in the use of the materials under consideration where its performance is equally comparable to the oxy-acetylene-fed gadget.
4. Emphasized the economic advantages of the proposed gadget vis-a-vis the oxy-acetylene welding.
5. Set the welding specifications.

Conceptual Framework

The design of the gasoline-fed welding machine proceeded through the following paradigm. It is operated manually (pedalled) to produce a certain pressure and a corresponding flame quality that would join selected materials out of fusion. The welding specification shall be formulated resulting from the trials conducted, as to which flame quality and pressure combinations would produce sound joints.

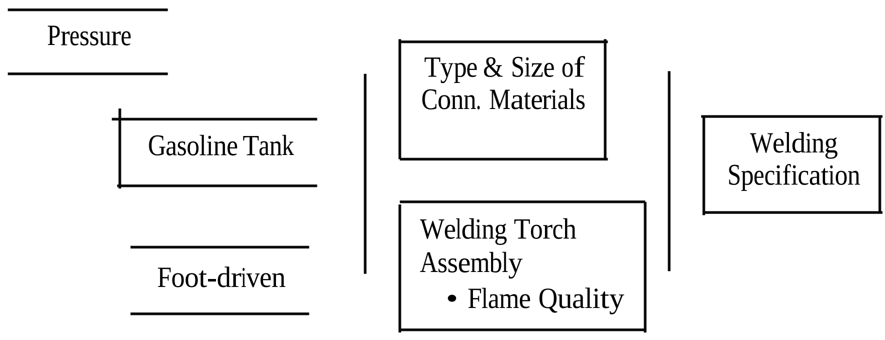


Figure1. The Research Paradigm

Related Literature

The following concepts are tools used by the researchers to develop the mechanism proposed herein.

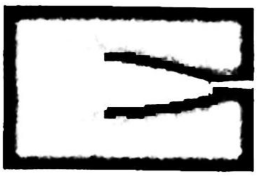
The Oxy-Acetylene Welding

Oxy-Acetylene welding uses the principle that when acetylene is mixed with oxygen in correct proportions and ignited, the resulting flame is one of the elements for burning. This flame which reaches a temperature of 630°F melts all commercial metals so completely that metals to be joined actually flow together to form a complete bond without the application of any mechanical pressure or hammering. In most instances, some extra metal in the form of a wire rod is added to the molten metal in order to build up the seam slightly for greater strength. In very thin materials, the edges are usually flanged and just melted together. In either case, if the weld is performed correctly, the section where the bond is made will be as strong as the based metal itself.

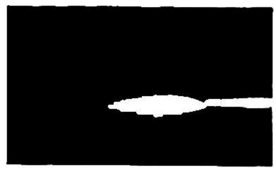
The oxy-acetylene flame is employed for **a** variety of other purposes, notably for cutting metal, case hardening, and annealing. As a matter of fact, it can be used in practically any situation which involves joining metal parts.

Oxyacetylene welding, commonly referred to as gas welding, is a process which relies on combustion of oxygen and acetylene. When mixed together in correct proportions within a hand-held torch or blowpipe, a relatively hot flame is produced with a temperature of about 3,200°C. The chemical action of the oxyacetylene flame can be adjusted by changing the ratio of the volume of oxygen to acetylene.

Three distinct flame settings are used, neutral, oxidizing and carburizing.



Neutral Flame



Oxidizing Flame

Carburizing Flame

Welding is generally carried out using the neutral flame setting which has equal quantities of oxygen and acetylene. The oxidizing flame is obtained by increasing just the oxygen flow rate while the carburizing flame is achieved by increasing acetylene flow in relation to oxygen flow. Because steel melts at a temperature above 1,500°C, the mixture of oxygen and acetylene is used as it is the only gas combination with enough heat to weld steel. (http://www.twi.co.uk/j32k/protected/band 3/jk3.html)

The **Blow** Torch

Blow torch is a common name for a simple heating torch, which bums liquid fuel with ambient atmospheric air after vaporizing it using a coiled tube passing through the flame. The blow torch is operated by air pressure and gasoline fuel. Its principle of operation uses gasoline as the primary fuel to braze copper tubes and metals. Air pressure is introduced inside the sealed tank with gasoline. (http://en.wikipedia.org/wiki/blowtorch)

The welding device is one of the most important tools for refrigeration and automotive technicians, electricians, tinsmitry and other allied works.

Operational Definition of Terms

To provide the reader a clearer understanding about the study, key words and phrases are defined as they were used in the research.

Acetylene. A colorless, highly flammable or explosive gas, CH, used for metal welding and cutting and as an illuminant. Also called *ethyne* It is the resulting gas from the chemical reaction between calcium carbide added to water. (http://www.answcrs.com/topic/acetylene?cat=health)

Alloy. A homogeneous mixture or solid solution of two or more metals. (http://www.answers.com/alloy?eat=health)

Aluminium. A silvery-white, ductile metallic element, the most abundant in the earth's crust but found only in combination.

Bronze. An alloy of copper and tin.

Copper. It is **a** soft, tough and ductile metal which could not be heat-treated but will harden when cold-worked.

Collapse under its own weight. The tendency of a joined metal to melt disallowing itself to be connected due to its exposure to a relatively high temperature, while the other joint metal has not yet reached its melting point.

Filler Rod. A material that acts as paste to facilitate the joining of metals when heated. For joining aluminum to another aluminum material, an aluminum filler rod and flux are required, for joining aluminum to copper, aluminum to steel copper alloy for strong bond; for copper, silver or bronze filler rod and borax flux is required for copper to copper connection, bronze to copper connection, copper to steel and copper to copper steel alloy for strong bond.

Flame Quality. The visual description of the temperature and pressure combination produced by the process of burning when oxygen and acetylene are combined in equal proportions, which could be: a) light, b) dull red, and c) bright/faint red.

a) Light color – flame is balanced (oxygen and acetylene) the molten metal flows smoothly like syrup, with very few sparks, cleanse clear

b) Dull Red Color – white/light cone becomes short and the color changes to dull red or purpush hue. The flame bums with a decided roar.

c) Bright/Faint Red – white cone appears at the tip enveloped by another fan-shaped cone which has a feathered edge. Metal melts. It has a tendency to boil.

Pressure. Force exerted per unit area.

Sound weld. A quality of welded materials where proper fusion of connected materials is attained, characterized by smooth and uniform lining of the edges.

Steel. A generally hard, strong, durable, malleable alloy of iron and carbon, usually containing between 0.2 and 1.5 percent carbon, often with other constituents such as manganese, chromium, nickel, molybdenum, copper, tungsten, cobalt, or silicon, depending on the desired alloy properties, and widely used as a structural material. (http://www.answers.com/steel)

Welding. is a fabrication process that joins materials, usually metals or thermoplastics, by causing coalescence. (http://en.wikipedia.org/wiki/Welding)

Methodology

This study made use of the experimental type of research in three phases:

Phase 1. Design and fabrication of gasoline receiver tank, fume gas reservoir tank and the welding torch to be used in undertaking the observations by combining the principle of the oxyacetylene and the blow torch discussed earlier.

• Phase 2. Qualitative testing to identify the capacity of the set-up as to the type of material connected, as well as the purpose of the welding connection, adjustments needed per type of material and purpose; observations as to the machine's performance when welding the identified materials, application to different filler rods, as well as position and motion of the torch.

Phase 3. Economic comparison of the proposed gadget with the oxy-acetylene welding.

Results and Discussion

Aller several trials, the results of welding two materials using the gasoline-fed gadget arc being reflected in Table 1, while the results when the same trials were done using oxy-acetylene are reflected in Table 2.

In Table I, the maximum pressure attained by the proposed set-up was only I psi. It can only produce light and dull red flame. A thorough analysis of Table 1 highlights the following observations:

I. Aluminium materials, 1/16" to I/8" in diameter, are joined soundly with just a light flame produced; but would collapse if the temperature is increased to cause a dull red flame.

2. Aluminium and copper with diameters ranging from I/16 in to 1/8" are joined soundly with a light flame; the aluminium would collapse when the flame turns dull red, but the copper is still in its normal state.

3. Aluminium and steel with diameters ranging from 1/16 in to 1/8" do not join with a light color flame; neither for a dull red flame, because the aluminium has reached its melting temperature while the steel has not yet reached its own.

4. The proposed gadget could not produce the sufficient temperature and pressure to join copper and steel materials together; neither is it capable to connect copper and steel together.

In Table 2, the maximum pressure attained by the oxy-acetylene was 3 psi, and it was capable to produce a bright/faint red quality of flame which the proposed gadget could not produce. The following are the significant observations noted:

I. With the same diameter of materials, aluminium has **a** sound weld with a light flame, while they melt with a dull red and bright/faint red flame. Similarly, the aluminium materials in Table I melted when joined with the dull red flame.

2. Exactly similar with the result in Table I, the same sized aluminium and copper are joined soundly with **a** light flame; the aluminium collapsed when the flame turned dull red, but the copper is still in its normal state; and while with the bright/faint red flame, the aluminium melted and a portion of the copper has been cut.

3. When aluminium was joined with steel, there was no successful connection because the aluminium melted ahead of the steel.

4. When copper materials with diameters ranging from 1/I6" to ?" were connected together, no fusion resulted with just a mere light red flame, a smooth, syrupy connection was made with the dull red flame, and not uniform thinning and cutting resulted when the flame was bright/faint red.

[illegible]

Type of Material Connected	[illegible]	Size/ Thickness of Connected Rod or Tube, in inches	[illegible]	[illegible]	[illegible]
A. Aluminum					
A.1. Aluminum to Aluminum	[illegible]	1/16 to 3/16	Light	[illegible]	Good jointing result
			Dull red	[illegible] its own weight	Destroyed (melted)
A.2. Aluminium to Copper	[illegible]	1/16 to 3/16	Light	[illegible] 1/16 to 1/8" diam	Good jointing result
			Dull red	Aluminium collapses under its own weight	Aluminum melts; copper is still in place.
A.3. Aluminum to Steel	[illegible]	1/16 to 3/16	[illegible]	[illegible]	Members could not join w/ the attained pressure
					Aluminum melts; steel retains its original appearance
B. Copper					
B.1. Copper to Aluminum (similar to A.2)	[illegible]	1/16 to 3/16	[illegible]	[illegible]	Good joints result
					Aluminum melts
[illegible]	[illegible]	1/16 to 3/16	[illegible]	[illegible]	Members could not join w/ the attained pressure
			[illegible]	[illegible]	Good jointing result
[illegible]	[illegible]	1/16 to 3/16		[illegible]	Members could not join w/ the attained pressure
			[illegible]	[illegible]	Copper melts
C. Steel					
C.1. Steel-to-Aluminum (similar to A.3)	[illegible]	1/16 to 3/16	[illegible]	Sound Weld for 1/16 to 1/8" diameter	Good joints result
			[illegible]	Sound Weld for 3/16" but not for ¼"	Aluminum melts
C.2. Steel-to-Copper (similar to B.3)	[illegible]	1/16 to 3/16			Members could not join
					Copper melts
[illegible]	[illegible]	[illegible]		[illegible]	Members could not join w/ the attained pressure
			[illegible]	[illegible]	Members could not join w/ the attained pressure

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	Welding Quality	
[illegible]						
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	Good jointing result for pressurized tube system for Refrigeration, Air conditioning, Auto-motive & Electrical works
				[illegible]	Collapse under its own weight	Members melt
				[illegible]	Collapse under its own weight	[illegible]
				[illegible]	Sound Weld better result w/ smooth ripples	[illegible]
A.2. Aluminium to Copper	[illegible]	[illegible]	[illegible]	[illegible]	The aluminum collapses under its own weight while metallic ring unites with copper.	[illegible]
				[illegible]	In a second aluminum collapsed while copper is destroyed in appearance due to some part will be cut	Aluminum melts
				[illegible]	The aluminium melts with smooth ripples, but the steel doesn't	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	Aluminun collapse under its own weight while steel turns red with metallic ring.	Aluminum melts
				[illegible]	Aluminium collapse while steel turns to red color and thinning its appearance	Aluminum melts

[illegible]

Type of Material Connected	[illegible]	[illegible]	Size/ Thickness of Conn. Rod or Tube		[illegible]	
[illegible]						
[illegible]		[illegible]	[illegible]	[illegible]	Sound Weld better result w/ smooth ripples	[illegible]
				[illegible]	The aluminum collapses under its own weight while metallic ring unites with copper.	[illegible]
				Bright/faint	In a second aluminum collapsed while copper is destroyed in appearance due to some part will be cut	[illegible]
				[illegible]	No fusion. The joined materials turn black	[illegible]
[illegible]	[illegible]	1 to 2 psi	1/16 to 1/4	[illegible]	Sound weld. Perfect fusion w/ uniform ripples.	Smooth, syrupy welded connection
				Bright/faint	Poor joint	No fusion, not uniform thinning and cutting appearance
				[illegible]	No fusion. The joined materials turn black	No fusion.
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	Sound weld. Perfect fusion w/ uniform ripples.	[illegible] syrupy welded [illegible]
				[illegible]	The flame destroys the copper while the steel turns red	[illegible]

[illegible]

Type of Material Connected	[illegible]	[illegible] 25%	Size/ Thickness of Conn. Rod or Tube	[illegible]	Welding Quality	[illegible]
[illegible]						
Steel to Aluminum	2 to 3 psi	2 to 3 psi	[illegible]	[illegible]	Sound weld/ good fusion w/ smooth ripples	[illegible] Jointing result
				[illegible]	Aluminun collapse under its own weight while copper steel alloy turns black with metallic ring.	[illegible]
				[illegible]	Aluminium collapse wile copper steel turn to red color and thinning its appearance	[illegible]
				[illegible]	No fusion. The joined materials turn black	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	Dull Red	Sound weld. Perfect fusion w/ uniform ripples.	[illegible]
				[illegible]	Destroy the copper while the steel turns red	[illegible]
				[illegible]	No fusion. The joined materials turn black	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	Sound weld. Perfect fusion w/ uniform ripples.	Smooth, syrupy [illegible] nection
				Bright/faint	Destroy the copper while the steel turns red	No fusion, not uniform [illegible]

I. Using the same sizes of copper and steel materials to be connected; only the dull red flame produced a successful joint.

2. Similarly, connected steel materials with diameters ranging from 1/16" to ¼" were only successful with the dull red flame.

Findings

The following findings were found to be significant:

a. From the Gasoline-fed welding machine

I. Aluminum requires just a light color of flame to be welded to another aluminum.
2. Aluminium requires just a light color of flame to attain a sound weld with copper.
3. Aluminium could not be welded to steel in any of the two flame qualities produced by the gasoline-fed welding machine.
4. Copper materials require dull red flame to fuse, thus, they could not attain any fusion with just a light color flame.
5. Copper and steel materials could not be welded.
6. Steel materials could not be welded together.

b. From the Oxy-acetylene Welding Machine

I. Aluminum requires just a light color of flame to be welded to another aluminum.
2. Aluminium requires just a light color of flame to attain a sound weld with copper.
3. Aluminium could not be welded to steel in any of the three flame qualities produced by the gasoline-fed welding machine.
4. Copper materials require dull red flame to fuse, thus, they could not attain any fusion with just a light color flame.
5. Copper and steel materials are welded soundly at dull red flame quality.
6. Perfect fusion occurred in connecting steel materials.

c. Economic Comparison Between the Gasoline Fed Welding and the Oxy-acetylene Welding Machine

In terms of financially comparing which of the two gadgets are more economical, the following computations were arrived at:

Parameters	Gasoline-fed	Oxy-acetylene-fed
Investment Cost	P 5,000	P 35,000
Consumption	Ph P42.75, or one (I) liter per hr of continuous welding	P 130.00 per hr of continuous welding Cost of Oxygen per tank – Pl,200 (rate of consumption= 1/16 of the tank per hr Cost of Acetylene per tank – P700 (rate of consumption= 1/10 of the tank per hr

Conclusions

Interpreting the observed results per applied pressure and temperature, with the type of material connected, the following conclusions could be derived:

1. Light color of flame suggests a pressure of0.5 psi (3.454 KPa) and temperature close to 3149°C
2. Dull red flame suggests a pressure of I psi (6.908 KPa) and temperature close to 3220°C
3. Bright/faint red flame indicates that a pressure from 2 psi to 3 psi (13.816 to 20.724 KPa) and a temperature close to 3260°C is already attained.
4. Aluminium melts at 343°C, and would attain a sound weld when connected to another aluminium material at this temperature.
5. The gas-fed welding machine is only capable of producing light and dull red color of flames, while the oxy-acytelene could produce three flame qualities: light, dull red and bright/faint red.
6. The proposed set-up could not connect steel materials to itself, and to other materials, specifically aluminium and copper.

Recommendations

In view of the above conclusions, the following recommendations are advanced. Table 3 below summarizes the specific technical field where the gasoline-fed welding performs equally well in comparison to that of oxy-acetylene welding as well as the assessed advantages to be derived in its use.

Table 3. Identified Technical Fields Where Gasoline Fed Welding is Advisable

Specific Technical Field	**Purpose**	**Advantage over Oxy-acetylene**
a. Refrigeration and Air Conditioning	For covering leaks and bracing joints, as well as for new installations using copper and aluminum tubes and wirings, like in the piping system of refrigerators, freezers, car aircons, split-type and window aircons.	Lighter More handy for home services More economical
b. Electrical Shop Works	For bracing/soldering of splices and joints of copper and aluminium wires which are common activities in electric motor repair and rewinding works. It is also advisable for interior and exterior house wiring installations.	More economical
c. Automotive Shops	For the repair of leaks, broken end joints of clutch, steering wheels and brake piping systems of automobiles.	More economical
d. Gold Smith	For broken gold jewelry repairs, gold smithing and melting of gold bars	More economical

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