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AUTOMATIC SIDE-STAND SLIDER ASSEMBLY

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Abstract: In modern developing world, automobile plays important role especially two-wheeler i.e (motorcycles& bikes) plays a major role. Even though they are helpful there are some sad events like accidents due to carelessness of rider. Major accidents occur due to forgetting of lifting side stand. To rectify this problem many advanced measures have been taken, but they are least helpful. So, to make a system that has a practical application which can be used on any type of two wheeler this project was undertaken. To reduce the mishaps, we have designed a new system with automatic stand retrieval.

The new system "AUTOMATIC SIDE-STAND SLIDER SYSTEM" has been designed based on the working principle of bikes. The system works on electronic circuits in the bike with the help of electronic components such as Servo motor, motor driver, Arduino for the retrieval of stand and to apply it.

In this system we make a demonstration model with a demo starter for bike and a frame used to hold starter, demo bike and side-stand in position. The frame is used to mount bike upright using frame. The starter consists of a circuit used to monitor the starter and then operate the stand sliding mechanism. The stand consists of a motorized system used to operate microcontroller the stand. The circuit monitors the starter, on starting the bike the side-stand is operated by the motor using a shaft to slide from a vertical position to a horizontal position. On turning off the key in other direction to lock bike the system moves the motorized stand shaft in opposite direction so as to move the stand in a direction perpendicular to the bottom frame rod which rests the motor bike on side stand. Thus we have a fully automated side-stand system for motor bikes.

Keywords: *Intrusion Detection Systems, Data mining, network, Vulnerable, Malicious, Authorization.*

I INTRODUCTION

The most commonly used mode of transport by the common public is a two wheeler. The two wheelers are most prone to accidents due to their fragile nature. There are various reasons for these vehicular accidents viz.

- Forgetting to lift side-stand
- Not maintaining the speed limit
- Not obeying traffic rules
- Others

One of the most common reasons amongst these is people's recklessness to slide their side-stands (lift up the stand) on starting their bike. Hence, here we propose an automated side-stand slider assembly which will lift the side-stand once the user starts his/her bike.

In the project, a demonstration model is executed; this model includes a demo starter for bike and a frame to Which a side-stand controlled by the servo motor is attached. The frame is used to display the stand's position (stand on/stand removed).The model consists of a microcontroller circuit that monitors the starter and then operates the stand sliding mechanism. On switching on the bike's ignition the side-stand assembly gets activated, as a result the side-stand operated by the servo motor slides from vertical position to horizontal position (i.e. stand removed). On turning off the key the side-stand assembly gets deactivated and functions in vice versa manner (i.e. stand on). Thus, we have a fully automated side-stand assembly for motor bikes.

PROBLEM STATEMENT

Introduce an "AUTOMATIC SIDE-STAND SLIDER ASSEMBLY" for minimising the rate of accidents caused by people's recklessness to slide their side-stands (lift up the stand) on starting their bike.

OBJECTIVES

- To propose an automated assembly that mandatorily controls the side-stand of the concerned vehicle in favour of its rider, while at rest or on drive.
- To minimise manual actuation and maximise automation for sliding of side-stand to increase the safety of the rider.
- To use low power consumption for the assembly.

SCOPE

- To reduce the accidents caused due to forgetting to retrieve the side-stand.
- Road safety.
- Economically efficient for both the manufacturer and the consumer.

METHODOLOGY

The modern two wheelers do not require a kick-start to ignite their engines; rather they are installed with auto-start or auto-ignition to perform this task as and when the key is turned on. For this installation to work, it is powered by a battery.

We noticed and studied the working of the key ignition powered by the battery and used it to our advantage to automate the side-stand actuation.

The "Automatic Side-Stand Slider Assembly" is an assembly designed for minimizing the accidents caused due to forgetting to retrieve the side-stand when the rider starts the two-wheeler. It works such that, as soon as the vehicle rider switches on the ignition key of the two-wheeler the side-stand of the two- wheeler gets retrieved and when the ignition key is turned off the side-stand gets into upright position automatically.

The "Automatic Side-Stand Slider Assembly" contains following electronic components:-

a. Servo Motor.

b. Motor Driver.

c. Arduino ATMEGA328p

d. Two Wheeler Battery

e. Ignition key

The servo motor is connected to side-stand with the help of coupling, for the operation of side-stand in desired manner. The servo motor works in stepped regulations and hence it is able to move the stand to any specific desired angle as per the requirement of the user. The servo motor is connected to the motor driver which initiates its movement and regulates its motion.

The motor driver is further connected to the controlling unit i.e. the microcontroller. The microcontroller used in the assembly is Arduino ATMEGA328p. The rationale for using this microcontroller being, a high performance low power controller with 8- bit and based on AVR RISC architecture. It has 32 pins which has different function of input and output. The arduino takes the input from the ignition key of the bike and provides the output accordingly to the motor driver as the input to actuate.

The two wheelers are installed with a Lithium Ion Battery. The whole assembly works on very low power and hence the battery of the two-wheeler can be used as the power supply. The assembly works on 12V and consumes very less battery.

The Arduino is to take the input from the ignition key and hence the arduino is attached to the ignition key (i.e. starter). The ignition input is taken from the starter as it turns on or off, accordingly the arduino will give input to the motor driver for the movement of the side-stand.

The arduino is programmed in such a manner that it rotates the stand backwards i.e. anticlockwise to an angle of 90° to retrieve it and to rotate forward i.e. clockwise to an angle of 90° to apply it in an upright position.

This way the side-stand assembly operates without the riders manual intervention i.e. automatically by just switching on/off the ignition of the vehicle. This in turn eliminates the risk of accidents caused by forgetting to retrieve the side-stand.

II LITERATURE REVIEW

A side-stand is a device on a bicycle or motorcycle that allows the bike to be kept upright without leaning against another object or the aid of a person. A side-stand is usually a piece of metal that flips down from the

frame and makes contact with the ground. It is generally located in the middle of the bike or towards the rear. Some touring bicycles have two: one at the rear, and a second in the front.

In the proposed model the team is going to present the "AUTOMATIC SIDE-STAND SLIDER ASSEMBLY". The proposed project works on a Servo Motor, which is connected to the side-stand, and is controlled with the help of embedded systems. A motor driver L293D is used for actuation and speed control of the motor.

HISTORY

The earliest known side-stand was designed by Albert Berruyer in 1869, and since then side-stands have been independently reinvented many times. It was mounted below the handlebars so was much longer than more recent designs. A shorter model was patented by Eldon Henderson in 1926.In the 1930s, a "smaller, more convenient" side-stand was developed by Joseph Paul Treen. In 1891, Pardon W, Tilling hast patented a design for a stand which was mounted on the pedal, but folded up flat under the pedal when not in use.

Side-stands on bicycles fell out of fashion in the 1970s, as the bicycles became lighter, and many riders were concerned about extra weight.

A side-stand is a device on a bicycle or motorcycle that allows the bike to be kept upright without leaning against another object or the aid of a person. A side-stand is usually a piece of metal that flips down from the frame and makes contact with the ground. It is generally located in the middle of the bike or towards the rear.

We may have witnessed motorcycle accidents because of the surface hindrance of retracted positioned side-stand. One of the most common problems that are encountered in using the side-stand is negligence or carelessness to kick back the side-stand. The negligence may be due to absence of mind, urgency, divergence in concentration and few other reas position released position "failure to kick back the side-stand", for any of the reasons stated above may hit and lead to accident of the vehicle and riders involve in the accident, sometimes fatal. To ensure safety of the rider, during absence of mind, negligence, urgency or carelessness the side-stand lock link helps in knowing the state of side-stand prior to movement of vehicle.

During a study it was found that about 36% of the accidents caused are due to riders negligence to retrieve the side-stand, 38% of the accidents are caused by not maintaining the speed limit, 22% of the accidents are caused by not obeying the traffic rules and 4% are caused due to other reasons. As a fair share of accidents are caused due to forgetting to retrieve the stand. Thus there is a need for a system that would help reduce the accidents caused by forgetting to retrieve stand.

TYPES OF STANDS

SIDE-STAND

A side-stand style stand is a single leg that simply flips out to one side, usually the non-drive side, and the bike then leans against it. Side-stands can be mounted to the chain stay sight behind the bottom bracket or to a chain and seat stay near the rear hub. Side-stand mounted right behind the bottom bracket can be bolted on, either clamping the chain stays, or to the bracket between them, or welded into place as an integral part of the frame.

CENTER STAND

A centre stand side-stand is a pair of legs or a bracket that flips straight down and lifts the rear wheeler off the ground when in use. Entre stands can be mounted to the chain stays right behind the bottom bracket or to the rear dropouts. &any motorcycles feature centre stands in addition to side-stands. The centre stand is advantageous because it takes most of the motorcycle's weight off its tires for long term parking, and it allows the user to perform maintenance such as chain adjustments without the need for a motorcycles, but are omitted on most high performance sport bikes to save weight and increase ground clearance.

The side-stand lock link relates to the field of automobiles industry, especially for two wheeler vehicles using side-stand apart from the aim centre stand provided therein for the resting of the vehicle. The side-stand lock link makes the contact with the gear lever there by indicating the person handling the vehicle about the unreleased side-stand when the rider tries to apply the gear in unreleased state of stand and prevents him from being endanger or to have unsafe ride of mo t or c yc l e . This prevents the rider as well the vehicle to lose the center of gravity by imbalance or surface hind range

due to retracted position of side-stands and there by saves life of the rider. The side-stand lock link is cheap, rugged and easier to install without traditional installations and fittings. The side-stand of a motor bike can be retracted automatically.

EXISTING METHODS

To prevent accidents occur due this side-stand many side-stand sensor and mechanical project had been found.

(a) SIDE-STAND SENSOR

A two-wheeler vehicle includes a frame and a metallic side-stand, rotatable within a bracket attached to the frame. The metallic side-stand is rotatable between a first position that supports the two-wheeler vehicle when parked and a second position substantially adjacent the frame. The two-wheeler vehicle also includes an inductive sensor attached to the two-wheeler vehicle and connected to detect at least one position of the metallic side-stand and a circuit connected to receive an output from the inductive sensor and to provide a signal that reflects the position of the side-stand.

Embodiments use inductive sensors to determine whether the side-stand is properly stowed. Inductive sensors detect metal objects, so that the side-stand itself can serve as the target. This allows the sensor to be operable without adding an additional target to the side-stand. The proposed side-stand sensor can be implemented in at least two ways: a) detecting the presence or absence of the metallic side-stand adjacent the inductive sensor or b) detecting the strain in a spring attached to the side-stand and translating that strain into a determined position.

In one aspect, an embodiment of a two-wheeler vehicle is disclosed. The two-wheeler vehicle includes a frame; a metallic side-stand, rotatable within a bracket attached to the frame, the metallic side-stand rotatable between a first position that supports the two-wheeler vehicle when parked and a second position substantially adjacent the frame; an inductive sensor attached to the two-wheeler vehicle and connected to detect at least one position of the metallic side-stand; and a circuit connected to receive an output from the inductive sensor and to provide a signal that reflects the position of the side-stand.

The side-stand detector includes an inductive sensor configured for attachment to the two-wheeler vehicle to detect at least one position of the side-stand; and a circuit connected to receive an output from the inductive sensor and to provide a signal that reflects the position of a side-stand.

(b)SPROCKET SIDE STAND RETRIEVE SYSTEM

In existing mechanical project many ideas had been found to lift the side-stand automatically.

Based on the working principle of two-wheeler (i.e the power is generated in the engine and it transmits power to the pinion and makes it to rotate. The pinion transmits power to the rear wheel pinion and makes the vehicle to move). This is the basic principle followed in all type of two-wheelers, based on this “automatic-side stand retrieve system” is designed because this system works by getting power from chain drive. This automatic system consists of four components, which is assembled as two set up.

The whole construction of this system is simple and efficient. The arrangement and position of components makes the system to function. Each and every component has its own property and responsibility. The power obtained from the chain drive is transmitted to the appropriate component without power loss. The systematic design of system is made in order to consume only very low amount of power initially for few seconds to retrieve the stand. Then the power consumption does not occur after retrieving the stand. Construction of the proposed “automatic side stand retrieve system” consists of four major components. They are:-

- Axle
- Sprocket pinion
- Lifting lever
- Pushing lever

Sprocket side stand retrieve system retrieves the side stand sprocket ally if the rider forgets to lift the side stand while moving the bike. It works based on the working principle of the two-wheelers .every bikes transmit power from engine’s pinion to the rear wheel

i.e. rotary motion of the pinion makes the linear motion of the chain. that linear motion of the chain is absorbed by rear wheel's sprocket and converted into rotary motion. That rotary motion of the rear wheel makes the bikes to move. Based on this Sprocket side stand retrieve system is designed.

If Sprocket is kept between the chain drive, it make the sprocket to rotate so, using the sprocket as the major component this system works. It gains the power from the chain and make specially designed component (lifting lever) to rotate. This rotation incites engaged pushing lever to push the side stand to retrieve.

When chain rotates anti-clockwise direction the inciter assemblies' sprocket absorbs the power and rotates in clockwise direction.

The working of "Sprocket-Side Stand Retrieve System is explained below in both (resting & riding condition of two-wheeler).

RESTING CONDITION:

When two-wheeler is in resting condition i.e. when rider actuates the side stand of the vehicle to ground, the pushing lever that is pivoted at the centre of the side stand gets engage with the inciter assemblies lifting lever. During this condition the inciter assembly is at rest and retriever assembly (pushing lever's tapered end get engage with tapered end of lifting Lever).

Pushing lever's length can be changed according to type of bikes and distance calculated between the side stand and chain drive. Closed coil helical spring which gets pulled, the coil of spring gets tensed during stand resting in ground .This is the condition of system during resting stage.

RIDING CONDITION:

When two-wheeler is started, Engine's pinion transmits power to the rear wheel by the chain drive. The inciter assembly which is kept at the centre of the chain drive gets rotates as the sprocket gets engage with chain drive. So, when the sprocket rotates the lifting lever mounted with axle rotates. hence the lifting lever lifts engaged the pushing lever and therefore the pushing lever pushes the side stand by clamping it with the C shaped clamp stand holder and hence the spring tensed in the side stand get compressed quickly as a result side stand get retrieves.

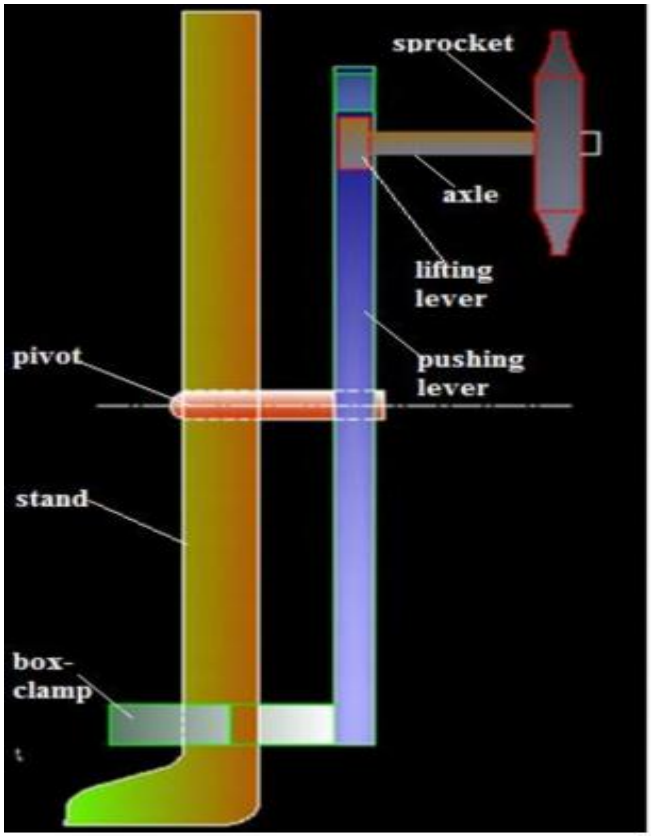

Figure 2.1:- Side View of Sprocket side stand retrieve system

These are some methods to retrieve side-stand automatically when the vehicle moves but it is not implemented in practical use due to its drawback

DRAWBACK OF EXISTING METHODS

The side-stand sensor only signals the rider by a blip on the speedometer interface and is ineffective when the rider is not paying attention.

When we come across those mechanical projects we could note some drawbacks like wear out of gears, making injuries in legs while actuating gears. Major drawback is it cannot be used in all types of two-wheelers.

So, in order to solve this problem we designed "AUTOMATIC SIDE-STAND SLIDER ASSEMBLY" this system can be attached in all type of two-wheelers (mopeds, geared, non-geared, hand geared bikes). Since the assembly works on electronic components there is no wear in gears and no injuries in legs while actuating gears. So all the drawbacks of the earlier attempts made to reduce the accidents can be overcome.

III WORKING

The modern two wheelers do not require a kick-start to ignite their engines; rather they are installed with auto-start or auto-ignition to perform this task as and when the key is turned on. For this installation to work, it is powered by a battery.

We noticed and studied the working of the key ignition powered by the battery and used it to our advantage to automate the side-stand actuation.

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The "Automatic Side-Stand Slider Assembly" contains following electronic components:-

a) Servo Motor.

b) Motor Driver.

c) Arduino ATMEGA328p

d) Two Wheeler Battery

e) Ignition key

The servo motor is connected to side-stand with the help of coupling, for the operation of side-stand in desired manner. The servo motor works in stepped regulations and hence it is able to move the stand to any specific desired angle as per the requirement of the user. The servo motor is connected to the motor driver which initiates its movement and regulates its motion.

The motor driver is further connected to the controlling unit i.e. the microcontroller. The microcontroller used in the assembly is Arduino ATMEGA328p. The rationale for using this microcontroller being, a high performance low power controller with 8- bit and based on AVR RISC architecture. It has 32 pins which has different function of input and output. The arduino takes the input from the ignition key of the bike and provides the output accordingly to the motor driver as the input to actuate.

The two wheelers are installed with a Lithium Ion Battery. The whole assembly works on very low power and hence the battery of the two-wheeler can be used as the power supply. The assembly works on 12V and consumes very less battery.

The Arduino is to take the input from the ignition key and hence the arduino is attached to the ignition key (i.e. starter). The ignition input is taken from the starter as it turns on or off, accordingly the arduino will give input to the motor driver for the movement of the side-stand.

Thus we understand that Automatic Stand Slider Assembly works on a servo motor which is connected to a motor driver. The motor driver is connected to the microcontroller. The microcontroller takes signal from ignition system. When the rider inserts the key and switches the ignition on or off, a signal is sent to the microcontroller which takes the signal as an input and processes whether it is on or off. The output signal is sent to the motor driver accordingly.

The motor driver receives an input signal from the microcontroller, which operates the servo motor. The motor Driver works as a regulator on the servo motor and sends it the signal on when and up to what degree should it operate. The motor driver in turn sends a signal to the servo motor.

The servo motor is actuated after receiving the signal from the motor driver. The servo motor is connected to the side stand. The servo motor rotates as per the signal received from the motor driver. The actuation of the servo motor according to the signal received is as follows:-

i. Ignition ON – Rotates anticlockwise 90°. Side-stand in rest position.

ii. Ignition OFF – Rotates clockwise 90°. Side-stand in upright position.

The microcontroller and the motor driver works on a program(Refer Annexure – I) for actuation of the servo motor. This program restricts and controls the movement of the stand according to the above ignition condition.

The following are the screenshots of the working from the video taken while experimentation.

Figure 3.1:- Bike Stand in Ignition OFF Position (Upright)

Figure 3.2:- Bike Stand in Ignition ON Position (Rest)

The above pictures show the upright (refer Fig 3.1) and rest (refer Fig 3.2) position of the side-stand. The side-stand position is upright when the ignition of the bike is off and it is in rest position when the ignition position is on. The ignition of the bike is on when the bike is in riding condition, hence the stand should be in rest position and be in the upright position only when the bike is not moving i.e. the ignition of the bike is off.

IV FUTURE PROSPECTS AND CONCLUSION

The proposed project "AUTOMATIC SIDE-STAND SLIDER ASSEMBLY" is cheaper than its mechanical alternatives. It requires minimum changes to the two-wheeler meaning that it can be implemented to any type of two-wheeler without the need for change in its design.

The stand is fully automated so there no need for manual actuation of stand the rider only needs to insert their key and the stand gets actuated.

Implementation of the model would reduce the accidents caused due to forgotten side stand retrieval, which is one of the major causes of accidents involving two-wheelers.

Hence it is concluded that the AUTOMTIC SIDE-STAND SLIDER ASSEMBLY is a necessity for the safety of the rider and it also gives the two wheeler aesthetic accessories.

Implementation Code

```
#include <Servo.h>
Servo myservo;  // create servo object to control a servo
const int key = 6;
const int servo = 10;
int pos = 0;    // variable to store the servo position
void setup() {
  // put your setup code here, to run once:
  pinMode(key, INPUT);
  myservo.attach(servo);  // attaches the servo on pin 9 to the servo object
  myservo.write(0);
  delay(1000);
}
void loop() {
  // put your main code here, to run repeatedly:
  if (digitalRead(key) == HIGH)
  {
    myservo.write(110);
    delay(1000);

    while (digitalRead(key) == HIGH);
    delay(100);
    while (digitalRead(key) == HIGH);
    if (digitalRead(key) == LOW)
    {
      myservo.write(0);
      delay(1000);
    }
  }
  else {
    myservo.write(0);
```

}

}

ACKNOWLEDGMENT

This work is not an individual contribution till its completion. We take this opportunity to thank all for bringing it close to the conclusion.

First of all we would like to thank our guide, Prof. Dange M. M. for continuously assessing our work providing great guidance by timely suggestions and discussion at every stage of this work.

Thanks to, Prof. Gawade M. N. Head of Department of Mechanical engineering for providing all facilities without which this seminar work would not have been possible. We sincerely thank to Prof. Rohakale M. S. Principal, SKNSITS, Lonavala.

REFERENCES

Side-stands for bicycles and motorcycles have been described in the patent literature since the 1800's. Examples include:

- 1891 – Fredrick G. Taylor and R.L. Granston "Bicycle Support", U.S. Patent 456, 347.
  "The object of this invention is to provide a new and useful device for supporting bicycles in an upright position, which…can conventionally carried on a bicycle in a position which will not interfere with the movement of the rider."
- 1926 – E.C. Henderson, "Leaning Support for Motorcycles", U.S. Patent 1,584,096 (Figure 1)
  "In my invention, I have pivoted a single support arm to one side of the vehicle frame…while the rider is seated thereon and balancing the vehicle in an upright position…the operator uses one of the feet to start moving the support bar back, and the tension spring forces the said support bar into the final resting position…"

The hazard associated with the sidestand is also discussed in the patent literature. The earliest is:

- 1928 – W.S. Harley and R. Constantine assignors to Harley Davidson Motor Co. , Milwaukee, "Cycle Support", U.S. Patent 1,675,551 (Figure 2)
  "Should the operator forget to move the support or stand to inoperative position, no difficulties could occur. For the reason the said support or stand will automatically become released from the notch 18 of the catch plate 17when the motorcycle is put in a vertical position."

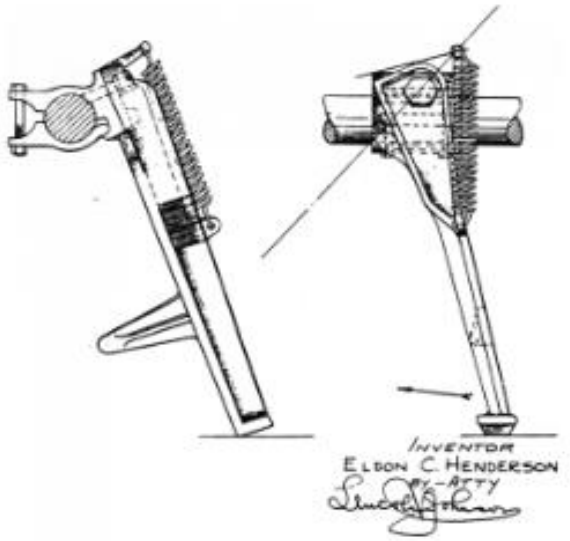

Figure 1: E.C. Henderson, U.S. Patent 1,584,096

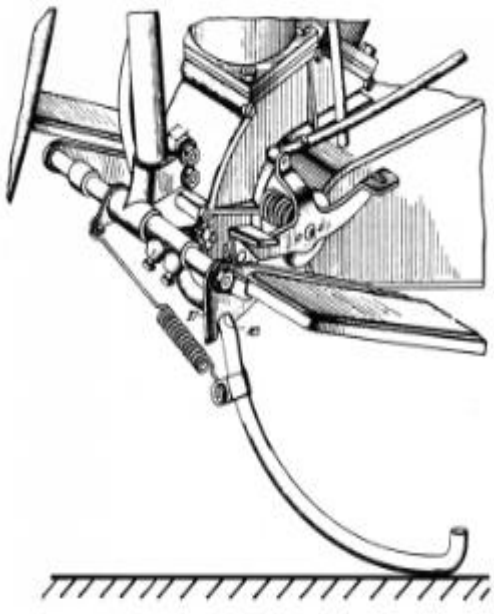

Figure 2: W.S. Harley & R. Constantine, U.S. Patent 1,675,551

Later examples are:

- 1942 – Milton V. Andrews, "Automatic Motorcycle Stand Retractor", U.S. Patent 2,300,762" Often the cyclist neglects to move the stand to its raised position and when a banked turn is made the stand strikes the ground and causes the motor cycle to be thrown to the ground, generally with serious consequences to both the cyclist and the motorcycle."

- 1975 – Sato Minoru, et al assigned to Honda Giken Kyogyo Kabuwaki Kaisha, Japan, "Side Stand for Motorcycle", U.S. Patent3,918,743
  "It takes place very often that riders of motorcycle star running their motorcycle without retracting or levelling the stand to its running position so that…at the time of the motorcycle being inclinedby a sharp turn, etc. the motorcycle inevitably overturns by the shock of the touch."
- 1978 – Yorio Yamazaki assigned to Kawasaki Jukogyo Kabushiki Kaisha, Japan, "Stand Device for a Two wheeled Motor Cycle", U.S. Patent 4,073,505
  "In the event that the rider forgets to move the stand from its operative position to its inoperative position when he starts the engine and brings the motorcycle to running condition there is the danger of impinging on surface of the road by the forwardly tilted end of the stand, for example, which causes to overturn the motorcycle and bring unexpected injury on the driver."
  Several International Standards address the side stand arrangement on motorcycles.
- U.S. Federal Motor Vehicle Safety Standard No. 123, "Motorcycle Controls and Displays", effective Sept. 1, 1974, states that : "A stand shall fold rearward and upwards if it contacts the ground when motorcycle is moving forward"
- The German Traffic Regulation No. 734, "Stands for Motorcycles without sidecars" (1976)*, contains a section almost identical to the American version, and in addition, it requires that powered motion of the motorcycle be able to occur only when the side stand is fully retracted unless the side stand is designed in such a way, that when folded down, it does not generate any safety risk.
- The Swiss November 1976 Amendment of, "The Construction and Equipment of Road Vehicles." * States that motorcycles must be provided with a parking stand which does not damage the road surface. The stand must automatically fold backward when the vehicle is driven.
- The November 1, 1978 revision of the Norwegian Regulations Regarding Motor Vehicles, Section 34, Chapter II, B* states that for new motorcycles, effective January 1979, the parking support of a motorcycle must be made so that when the weight of the motorcycle is removed from it, it returns automatically to a resting position; or it must be placed in a resting position before the machine can be driven.
  Instructions to stow the side stand prior to riding, and warnings describing the describing the serious consequences of failing to do so have appeared in manuals and other literature since the early seventies.
- Kawasaki Owner's Manuals have warned since 1973 that :
  "Forgetting and leaving the side stand while riding could cause an accident."
- Suzuki Owner's Manuals instruct owners of late seventies models :
  "Before starting off turn back the prop stand fully to its normal position."
  Warnings and instructions are expected to reduce riders' forgetfulness by making them aware of the danger associated with leaving the side stand in a parked position.
  Following are other references taken to observe the accident pattern and the safety precautions and measures taken to avoid causing these accidents
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- Reeder, A.I., Chalmers,D.J. and Langeley, J.D. The risky and protective motorcycling opinions and behaviours of young on road motorcyclist in New Zealand

- A journal paper 'motorcycle accidents- case study and what do learn from them' by Ecker, H. Viema University of Technology,
- Hurt, H.H., Ouellet, J.V. and Thom, D.R. Motorcycle accident cause factors.
- Grayson, G. and Hakkert, A. Accident analysis and conflict behaviour.
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- Yin, R.K., case study research, Applied Social research Methods vol. 5. London Sage Publication.

- Frederick G. Taylor and R.L Granston, "bicycle support", U.S. patent 56,347

- W.S. Harley and Arthur R. Constantine assignors to Harley Davidson Motor Co., Milwau-kee, "Cycle Support", U.S. Patent 1,675,551

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- https://circuitdigest.com/article/servo-motor-basics/ 12/09/2019 .

- www.robokart.com/ 09/01/2020 (for purchase of components).